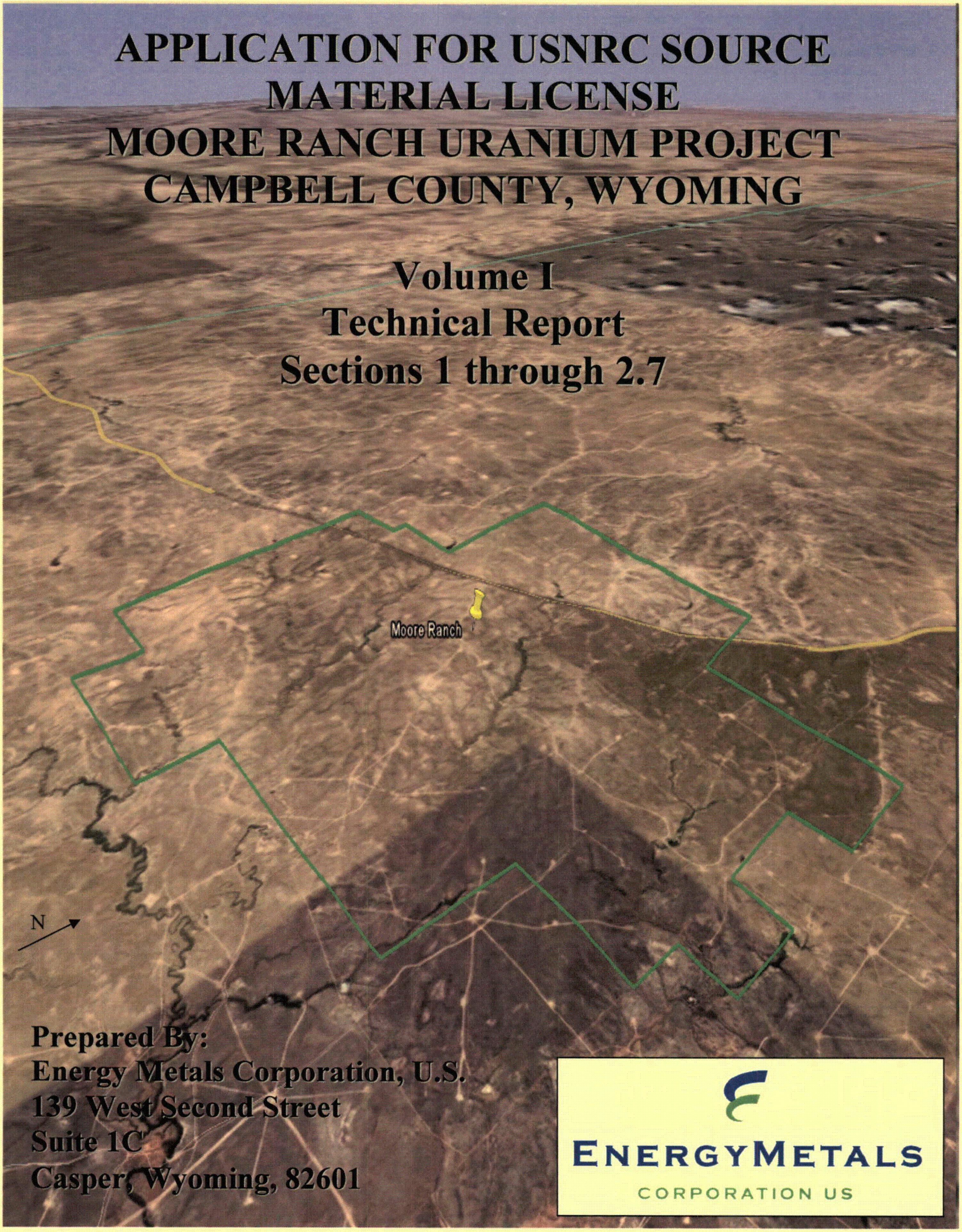
# APPLICATION FOR USNRC SOURCE MATERIAL LICENSE
# MOORE RANCH URANIUM PROJECT
# CAMPBELL COUNTY, WYOMING

## Volume I
## Technical Report
## Sections 1 through 2.7




**Prepared By:**
**Energy Metals Corporation, U.S.**
**139 West Second Street**
**Suite 1C**
**Casper, Wyoming, 82601**

ENERGYMETALS
CORPORATION US

# TABLE OF CONTENTS

# TABLE OF FIGURES

## Section 1



## Section 2

## Section 3



## Section 5



## Section 6



## Section 7

# TABLE OF TABLES

## Section 3



## Section 5

# List of Addendums



# List of Appendices

# 1 PROPOSED ACTIVITIES

## 1.1 LICENSING ACTION REQUESTED

Energy Metals Corporation US (EMC) is providing this Technical Report in support of an application to the United States Nuclear Regulatory Commission (NRC) for a Radioactive Source Materials License to develop and operate the Moore Ranch Uranium Project, located in Campbell County, Wyoming, by in situ recovery methods. The proposed project will consist of injection/production wellfields, a central plant with ion exchange, resin unloading, elution, precipitation, and yellowcake drying capabilities, and deep injection disposal well(s). EMC controls the uranium resources on the proposed property.

This application and Technical Report has been prepared using suggested guidelines and standard formats from both state and federal agencies. The Technical Report is presented primarily in the NRC format found in Regulatory Guide 3.46, *"Standard Format and Content of License Applications, Including Environmental Reports, For In Situ Uranium Solution Mining"* (June 1982). NRC document NUREG-1569, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications* (June 2003) was used to ensure that all information is provided to allow NRC Staff to complete their review of this license application.

## 1.2 MOORE RANCH PROJECT BACKGROUND

The original development of what is now the Moore Ranch Project was conducted by a joint venture between Conoco, Kerr McGee Uranium, and Wold Uranium with Conoco controlling approximately 50% of the joint venture. The project was referred to as the Moore Ranch Mine and Sand Rock Mill Project and much of the exploration and license related work was conducted from the mid-1970s through the early-1980s. Conoco reported discovery and delineation of several mineralized areas in the vicinity.

Conoco delineated 3 planned open pit areas with drilling on 50-foot centers and completed approximately 130 core holes on the property. Applications were developed for both a WDEQ-LQD mine permit and a USNRC Source Materials License (Docket No. 40-8743), including all required baseline information. A draft Environmental Statement (for the Sand Rock Mill Project) was completed by the NRC in March 1982. However, declining market conditions forced development and licensing activities of the project to cease.

## 1.3 CORPORATE ENTITIES INVOLVED

This License Application and Technical Report were prepared and are submitted by Energy Metals Corporation (US), a wholly-owned subsidiary of Energy Metals Corporation (EMC). EMC is a Canadian Corporation with Corporate Headquarters in Vancouver, British Columbia, Canada. EMC (US) maintains a Corporate Headquarters in Edmond, Oklahoma with regional offices in Casper, Wyoming and Corpus Christi, Texas.

On August 10, 2007, Uranium One acquired all outstanding shares of EMC. Uranium One is a Canadian Corporation, also headquartered in Vancouver, British Columbia, Canada. Consolidation and organization of EMC with Uranium One is currently in progress with expected completion in approximately six months. Depending on the outcome of the consolidation and organization process, EMC or its successor organization may submit amended Corporate Entity information to the NRC.

## 1.4 SITE LOCATION AND DESCRIPTION

The Moore Ranch Uranium Project is located in Campbell County, Wyoming within Township 42 North, Range 75 West, Sections 26, 27, 33, 34, 35, 36 and Township 41 North, Range 75 West, Sections 1, 2, 3, and 4, and Township 42 North, Range 74 West, Section 31. The project site is located between the towns of Wright and Edgerton. Access to the project site is from Wyoming State Highway 387, which runs through the project area. Access to the site from the highway is available through gravel and two-track roads established from coal bed methane development and agricultural activity. The project will consist of wellfields, an ion exchange facility, wastewater disposal wells and processing and drying facility. More information on site location is contained in Section 2.1.

The minerals leased in the Moore Ranch Project area are on private lands. Figure 1.4-1 shows the land ownership in the proposed Moore Ranch Project area and Figure 1.4-2 shows the mineral ownership.

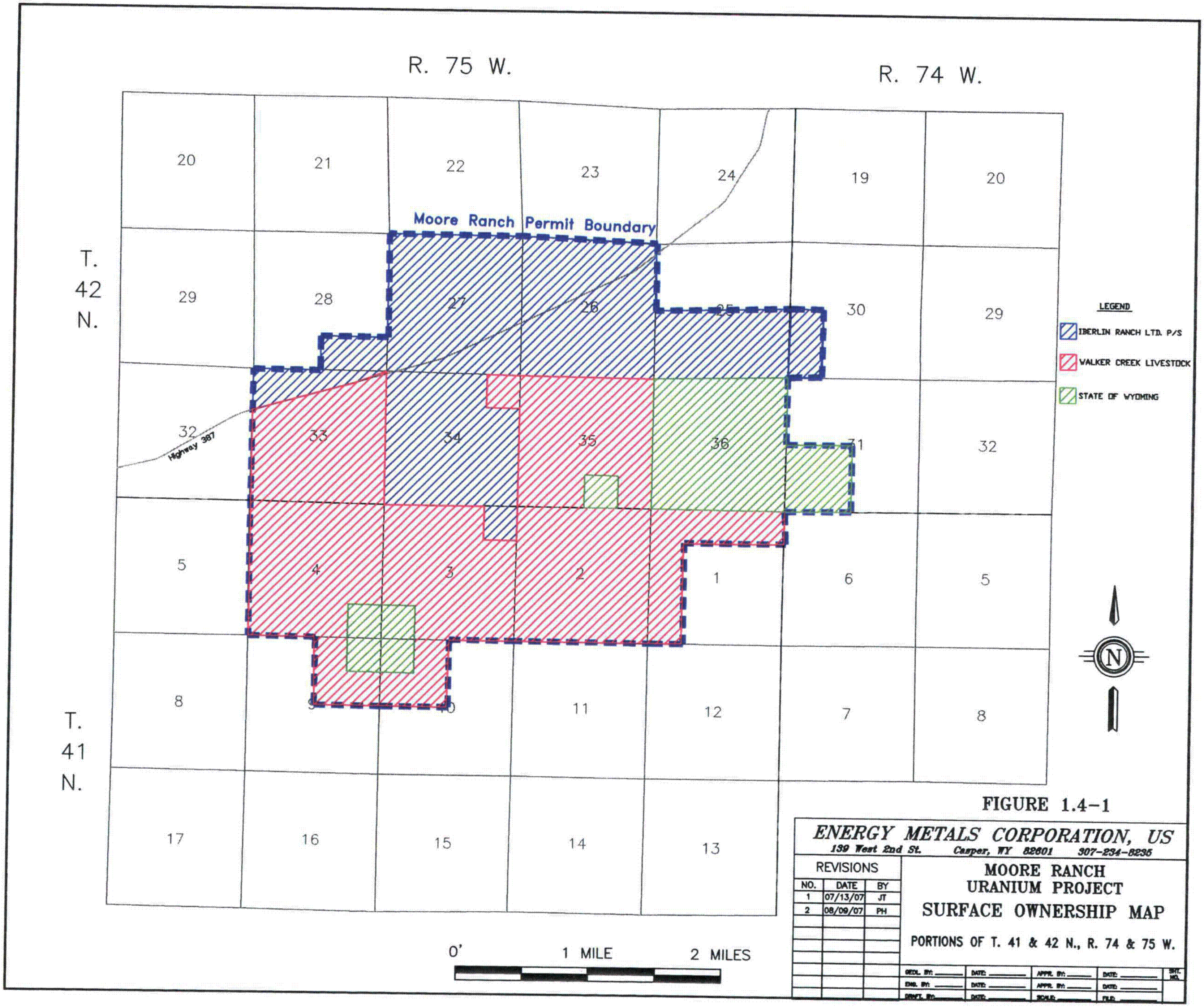

R. 75 W.
R. 74 W.
T. 42 N.
T. 41 N.
Moore Ranch Permit Boundary
Highway 387
20
21
22
23
24
19
20
29
28
27
26
25
30
29
32
33
34
35
36
31
32
5
4
3
2
1
6
5
8
9
10
11
12
7
8
17
16
15
14
13
LEGEND
IBERLIN RANCH LTD. P/S
WALKER CREEK LIVESTOCK
STATE OF WYOMING
N
0'
1 MILE
2 MILES
ENERGY METALS CORPORATION, US
139 West 2nd St. Casper, WY 82601 307-234-8235
REVISIONS
NO. DATE BY
1 07/13/07 JT
2 08/09/07 PH
MOORE RANCH
URANIUM PROJECT
SURFACE OWNERSHIP MAP
PORTIONS OF T. 41 & 42 N., R. 74 & 75 W.
GEOL. BY:
DATE:
APPR. BY:
DATE:
SHT. NO.
ENG. BY:
DATE:
APPR. BY:
DATE:
DRAFT. BY:
DATE:
SCALE:
FILE:

FIGURE 1.4-1

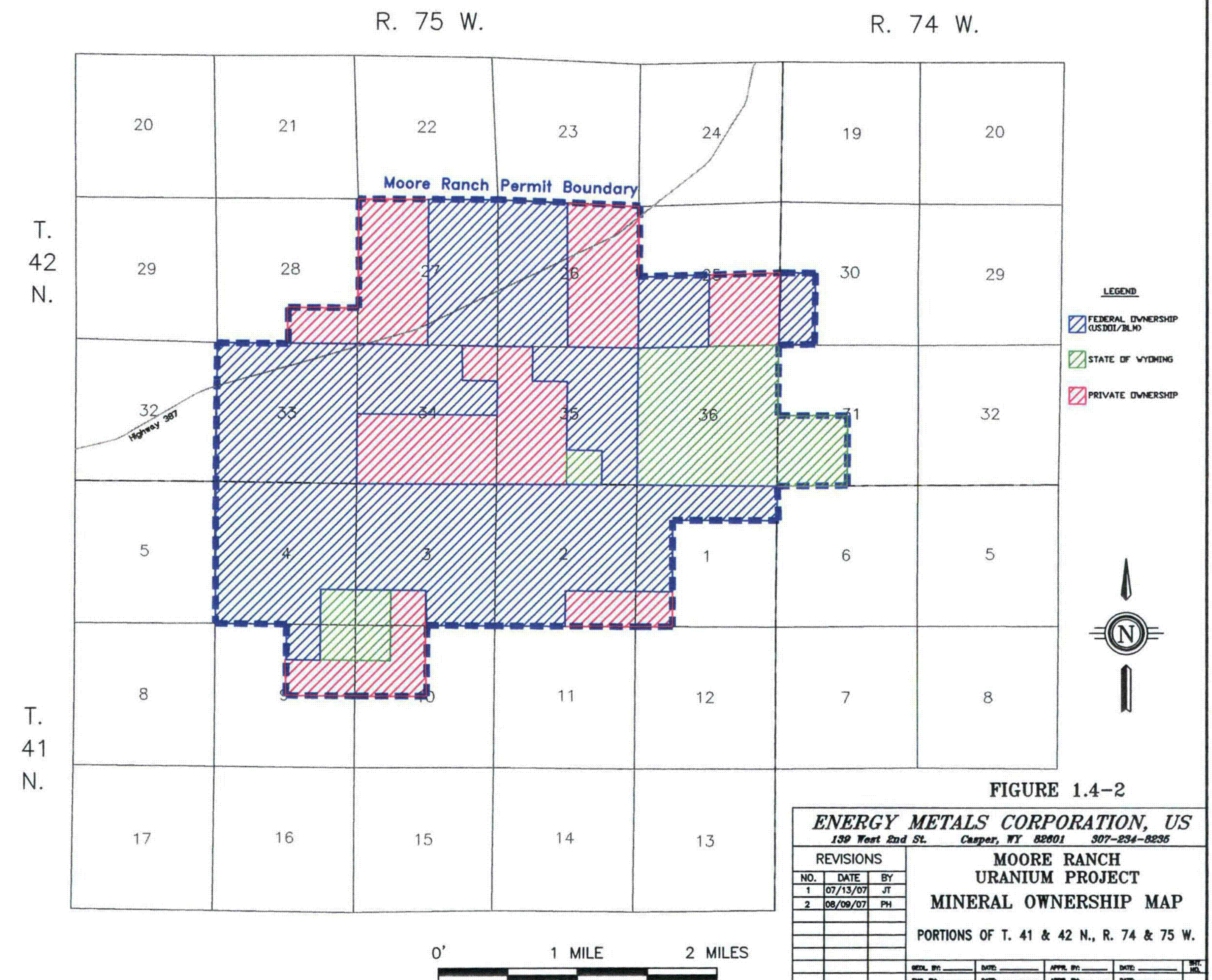



FIGURE 1.4-2

*ENERGY METALS CORPORATION, US*
*139 West 2nd St. Casper, WY 82601 307-234-8235*

MOORE RANCH
URANIUM PROJECT
MINERAL OWNERSHIP MAP

PORTIONS OF T. 41 & 42 N., R. 74 & 75 W.

| REVISIONS | | |
|---|---|---|
| NO. | DATE | BY |
| 1 | 07/13/07 | JT |
| 2 | 08/09/07 | PH |

GEOL. BY: DATE: APPR. BY: DATE: SHT. NO.
ENG. BY: DATE: APPR. BY: DATE:
DRAFT. BY: DATE: SCALE: FILE:

## 1.5 OREBODY DESCRIPTION

Uranium ore within the Moore Ranch Site occurs in typical roll-front deposits. The ore is found in a coarse-to very course-grained sandstone, termed the "70-sand", which averages approximately 80 feet thick in the proposed mining areas. However, the ore intercept in any particular hole is only a fraction of the total thickness and rarely exceeds 25 feet. Mineable ore reserves are estimated at an average grade of approximately 0.1%. The depth of the ore bodies ranges from 250 to 300 feet, while the width of the roll fronts typically ranges from 100 to 1000 feet.

## 1.6 SOLUTION MINING METHOD AND RECOVERY PROCESS

The in situ recovery (ISR) process for uranium recovery consists of an oxidation step and a dissolution step. Gaseous oxygen or hydrogen peroxide is used to oxidize the uranium, and carbon dioxide or bicarbonate is used for dissolution. The carbonate/bicarbonate recovery solution and oxidant are injected into the ore bearing sandstone formation through a series of wells that have been drilled, cased, cemented, and tested for mechanical integrity. As the recovery solution and oxidant move through the formation and contact the ore, the uranium is first oxidized, and then complexes with the carbonate to form a soluble salt that aids in the dissolution of the uranium. The uranium bearing solution is drawn to a recovery well where it is pumped to the surface and transferred to the recovery plant. In the plant, the process uses the following steps to process uranium from the recovered solutions:

- Loading of uranium complexes onto ion exchange resin;
- Reconstitution of the leaching solution by the addition of carbon dioxide and/or carbonate/bicarbonate and oxidant (gaseous oxygen or hydrogen peroxide), which is sent back to the wellfields for continued operations;
- Elution of the uranium complexes from the resin;
- Precipitation of uranium complexes from the eluate;
- Drying and packaging of the uranium.

During the mining process, slightly more water is produced from the ore-bearing formation than is injected. This net withdrawal, or "bleed", produces a cone of depression in the mining area, controlling fluid flow and confining it to the mining zone. The mined aquifer is surrounded, laterally, above and below, as necessary, by monitor wells that are frequently sampled to ensure that all mining fluids are retained within the mining zone. The "bleed" also provides a chemical purge on the aquifer to limit the buildup of species such as sulfate and chloride that are affected by the recovery process.

The ISR mining process selectively removes uranium from the ore body. No tailings are generated by the process, thus eliminating a major concern associated with conventional uranium mining. When installing an ISR wellfield, only limited surface disturbance occurs. During the operating life of the wellfield, vegetation is re-established over the wellfields and pipeline corridors to prevent erosion and buildup of undesirable weeds.

### 1.6.1 Advantages of ISR Uranium Mining

ISR uranium mining is a proven technology that has been successfully demonstrated commercially in Wyoming, Texas, and Nebraska. ISR mining of uranium is environmentally superior to conventional open pit and underground uranium mining as evidenced by the following:

1. ISR mining results in significantly less surface disturbance as mine pits, waste dumps, haul roads, and tailings ponds are not needed;

2. ISR mining requires much less water demand than conventional mining and milling, avoiding the water usage associated with pit dewatering, conventional milling, and tailings transport;

3. The lack of heavy equipment, haul roads, waste dumps, etc. results in very little air quality degradation at ISR mines;

4. Fewer employees are needed at ISR mines, thereby reducing transportation and socioeconomic concerns;

5. Aquifers are not excavated, but remain intact during and after ISR mining;

6. Tailings ponds are not used, thereby eliminating a major ground water pollution concern. State of the art lined evaporation ponds may be used to manage liquid waste streams; and

7. ISR uranium mining results in leaving the majority of other contaminants (e.g., heavy metals) where they naturally occur instead of moving them to waste dumps and tailings ponds where their presence is of more environmental concern.

### 1.6.2 Ore Amenability to the ISR Mining Method

Amenability of the uranium deposits in the Moore Ranch Project area to ISR mining has been demonstrated through existing, nearby ISR projects in the Powder River Basin in Wyoming (Smith Ranch/Highland Project and Christensen Ranch/Irigaray Projects). These projects demonstrate that in situ recovery methods can efficiently mine and restore roll front uranium deposits in a cost effective manner with minimal environmental impacts and with no significant risk to the public health or safety.

Due to the close proximity of the Moore Ranch Project to these established ISR projects, industry information and experience gained during operations of these projects, typical roll front geology, typical confined aquifer systems, and similar use of best practicable technology, EMC believes that ISR methods can be successfully employed at the Moore Ranch Uranium Project along with concurrent environmental monitoring programs to ensure that any impact to the environment or public is minimal.

## 1.7 OPERATING PLANS, DESIGN THROUGHPUT, AND PRODUCTION

The Moore Ranch Central Plant will operate at a flow rate of 3,000 gpm. The central plant will serve production from Moore Ranch ISR operations and will process resin from other potential EMC satellite projects in the area, or resin received through potential tolling arrangements with other in situ operations licensed under a different operator. The central plant will be initially designed and constructed to produce 2 million to 3 million pounds of $U_3O_8$ per year. Capacity is expected to be expanded to 4 million pounds per year as these other potential satellite projects are licensed and production increases. This license application analyzes the environmental effects of a 4 million pound per year operation.

Total mineable reserves for the Moore Ranch Project are not fully developed at this time. Known resources to date are approximately 5.8 million pounds in the ground.

The uranium extracted from the Moore Ranch Project will be loaded onto ion exchange resin in the plant, which will then be transferred to other areas of the plant for elution, and ultimately precipitation, drying and packaging of uranium. Barren resin will be returned back to the appropriate portion of the ion exchange circuit

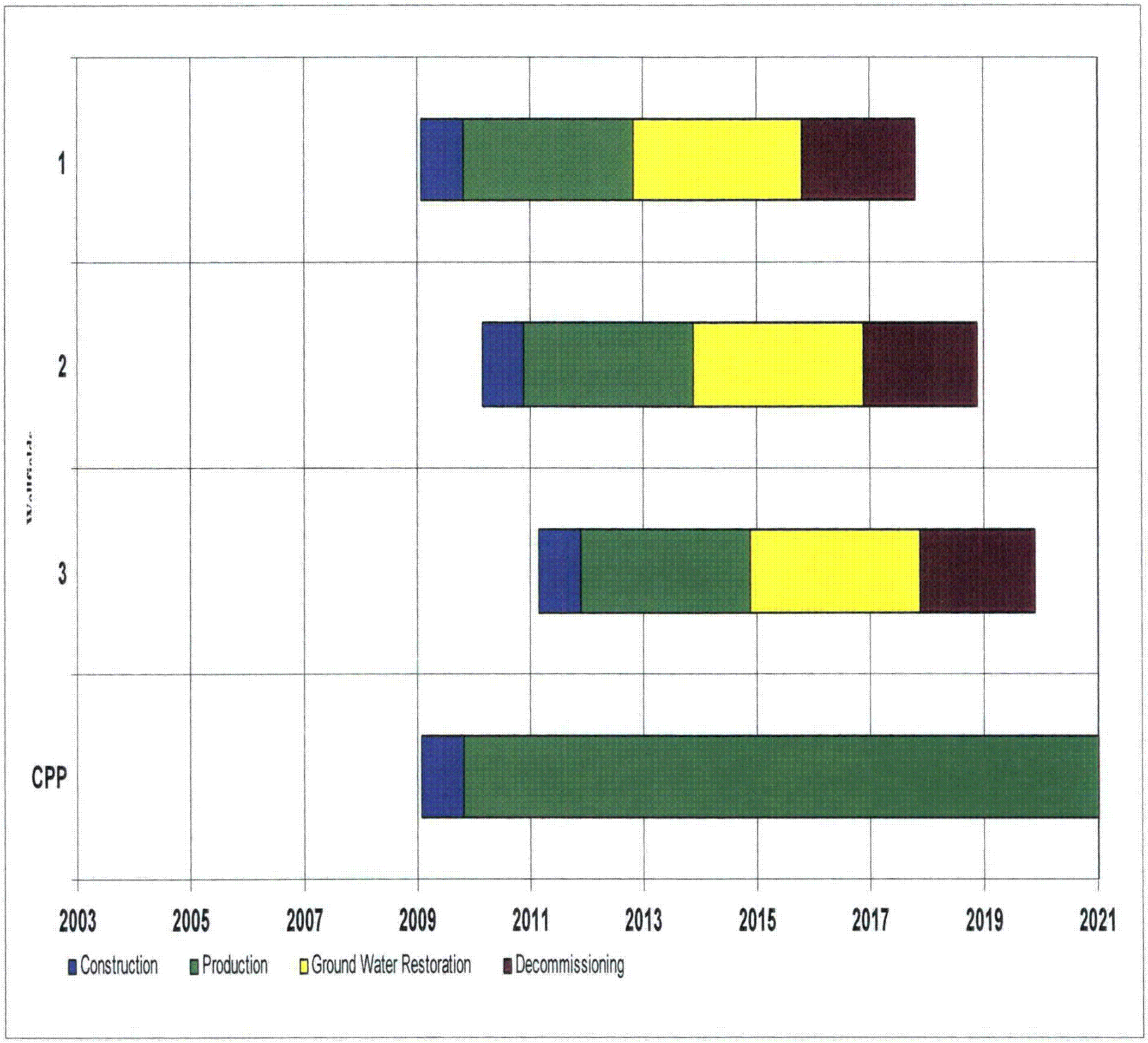
## 1.8 OPERATING SCHEDULES

### 1.8.1 Moore Ranch Construction, Operation, and Restoration Schedule

Following approval of the NRC Source Material License, construction of Wellfield 1, the central plant, and ancillary facilities is planned to begin in February of 2009. Completion of the central plant and ancillary facilities, deep disposal wells, and all or a portion of wellfield 1 is expected to be completed in November 2009 and startup of operations will commence. Construction of Wellfields 2 and 3 will follow within the next two years respectively. Projected production and restoration schedules for the proposed Moore Ranch Project are shown in Figure 1.8-1.

Additional wellfield plans are developed approximately one year prior to the planned commencement of new mining operations. The layout of the planned wellfields is shown in Figure 1.8-2. It is currently anticipated that ISR operations and wellfield restoration will continue for approximately 10 years. At this point, decommissioning of wellfields including well abandonment, piping and equipment removal, wellfield building removal, surface scanning and reclamation will commence. It is anticipated that the central plant will continue operations past 10 years and after decommissioning of Moore Ranch wellfields in order to accommodate processing of other potential satellite projects in the Powder River Basin area.

**Figure 1.8-1** Moore Ranch Project Production, Restoration and Decommissioning Schedule



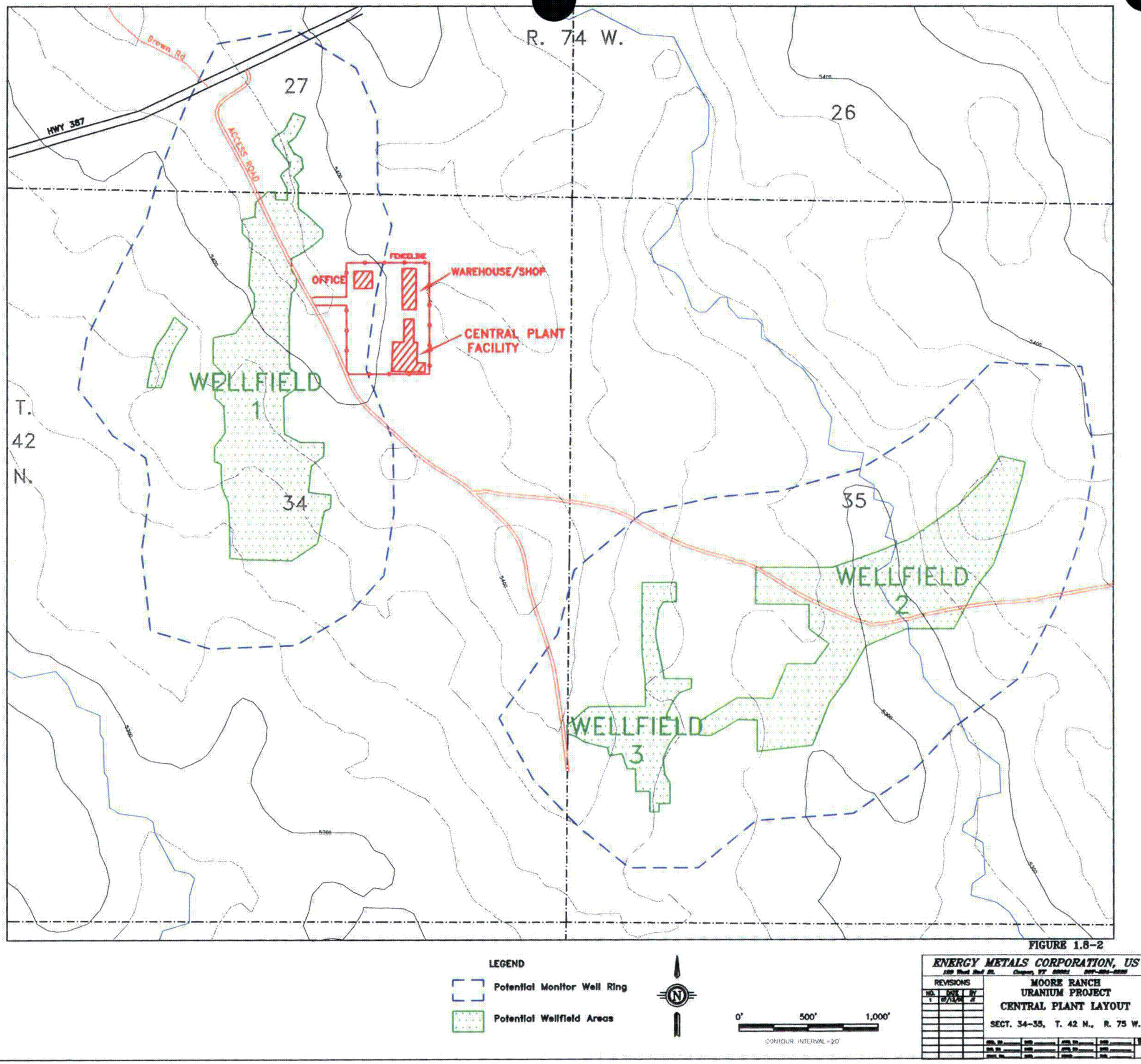

R. 74 W.
T. 42 N.
27
26
34
35
HWY 387
Brown Rd
ACCESS ROAD
FENCELINE
OFFICE
WAREHOUSE/SHOP
CENTRAL PLANT FACILITY
WELLFIELD 1
WELLFIELD 2
WELLFIELD 3
LEGEND
Potential Monitor Well Ring
Potential Wellfield Areas
0'
500'
1,000'
CONTOUR INTERVAL=20'
ENERGY METALS CORPORATION, US
REVISIONS
MOORE RANCH
URANIUM PROJECT
CENTRAL PLANT LAYOUT
SECT. 34-35, T. 42 N., R. 75 W.

FIGURE 1.8-2

## 1.9 WASTE MANAGEMENT AND DISPOSAL

### 1.9.1 Liquid Waste

Wastewater disposal for the Moore Ranch Project will be done through deep well injection. Deep injection has been utilized by ISR operations throughout the Powder River Basin. The deep injection well(s) will be permitted in accordance the WDEQ-WQD Class I UIC rules and regulations.

The operation of the process facility results in three sources of water that are collected on the site. They include the following:

- **Liquid process waste** - The operation of the process plant results in two primary sources of liquid waste, an eluant bleed and a production bleed. This water will be injected into the deep disposal well(s).

- **Aquifer restoration** - Following mining operations, restoration of the affected aquifer commences which results in the production of wastewater. The restoration waste is primarily from the first phase of aquifer restoration, groundwater sweep. The second source is brine from the reverse osmosis unit, which is sent to the waste disposal system. The permeate is either reinjected into the wellfield or sent to the waste disposal system. Wastewater from both groundwater sweep and the reverse osmosis phases of restoration are injected into the deep disposal well(s).

- **Water collected from wellfield releases** - This water is injection lixiviant or recovery fluids recovered from areas where a liquid release has occurred from a well or pipeline. These occurrences are very infrequent and typically contain small volumes for disposal. The water will be placed into the wastewater disposal system for deep well injection.

Domestic liquid waste will be disposed of in an on-site wastewater treatment (i.e., septic) system properly permitted by the County under the WDEQ-WQD Class V Underground Injection Control (UIC) Regulations.

Sources and methods of handling liquid wastes are discussed in more detail in Section 4.

### 1.9.2 Solid Waste

Solid wastes generated consist of spent resin, resin fines, filters, miscellaneous pipe and fittings, and domestic waste. These wastes are classified as contaminated or non-contaminated waste according to radiological survey results. Contaminated 11e.(2)

byproduct waste that cannot be decontaminated is packaged and stored until it can be shipped to a licensed waste disposal site or licensed mill tailings facility.

Non-contaminated solid waste is collected on site on a regular basis and disposed of in a sanitary landfill permitted by the WDEQ.

### 1.9.3 Contaminated Equipment

Materials and equipment that become contaminated as a result of normal operations are decontaminated if possible and disposed of by conventional methods. Equipment and materials that cannot be decontaminated are treated in the same manner as other contaminated 11e.(2) byproduct material.

## 1.10 GROUNDWATER RESTORATION

Restoration activities will be carried out at the Moore Ranch Uranium Project concurrent with mining activities. The restoration process will be similar to that used to restore wellfields at current existing ISR operations, and may consist of the following activities:

- **Groundwater sweep**- water is pumped from the wellfield, which results in an influx of native groundwater from outside the wellfield.

- **Groundwater treatment**- water from production wells is pumped to the restoration plant where ion exchange, reverse osmosis, chemical reduction, filtration or other treatment methods take place.

- **Bioremediation**- bioremediation agents may be added to the injection stream to increase microbial activity to promote reduced conditions.

It may not be necessary to use all of the phases described above to meet restoration goals. Following these restoration phases, a groundwater stabilization monitoring program is initiated. Once the restoration values are reached and maintained, restoration is deemed complete. Results are documented in a Restoration Report and submitted to the WDEQ and the NRC for approval. Groundwater restoration is described in more detail in Section 6.

## 1.11 DECOMMISSIONING AND RECLAMATION

Surface and subsurface facilities in individual wellfields may be decommissioned following the completion and agency acceptance of groundwater restoration. This wellfield decommissioning includes the plugging and abandonment of all injection and production wells and the removal of wellfield piping and structures that are no longer required for operation of the mine.

At the completion of mine life and after groundwater restoration has been completed, all the site will be fully decommissioned. Decommissioning will include the removal of remaining wellfield piping and equipment, demolition and disposal of contaminated buildings and structures, and reclamation of all disturbed areas. Appropriate NRC guidance will be followed during decommissioning as required. Decommissioning and reclamation are discussed in more detail in Section 6.

## 1.12 SURETY ARRANGEMENTS

A financial surety arrangement consistent with 10 CFR 40, Appendix A, Criterion 9 will be in place prior to the construction and startup of operations to cover the estimated costs of reclamation activities. The surety amount will be revised annually to reflect the estimated costs of reclamation activities for the Moore Ranch Project as development activities proceed. The estimated reclamation costs and surety arrangements are discussed in more detail in Section 6.

# 2 SITE CHARACTERISTICS

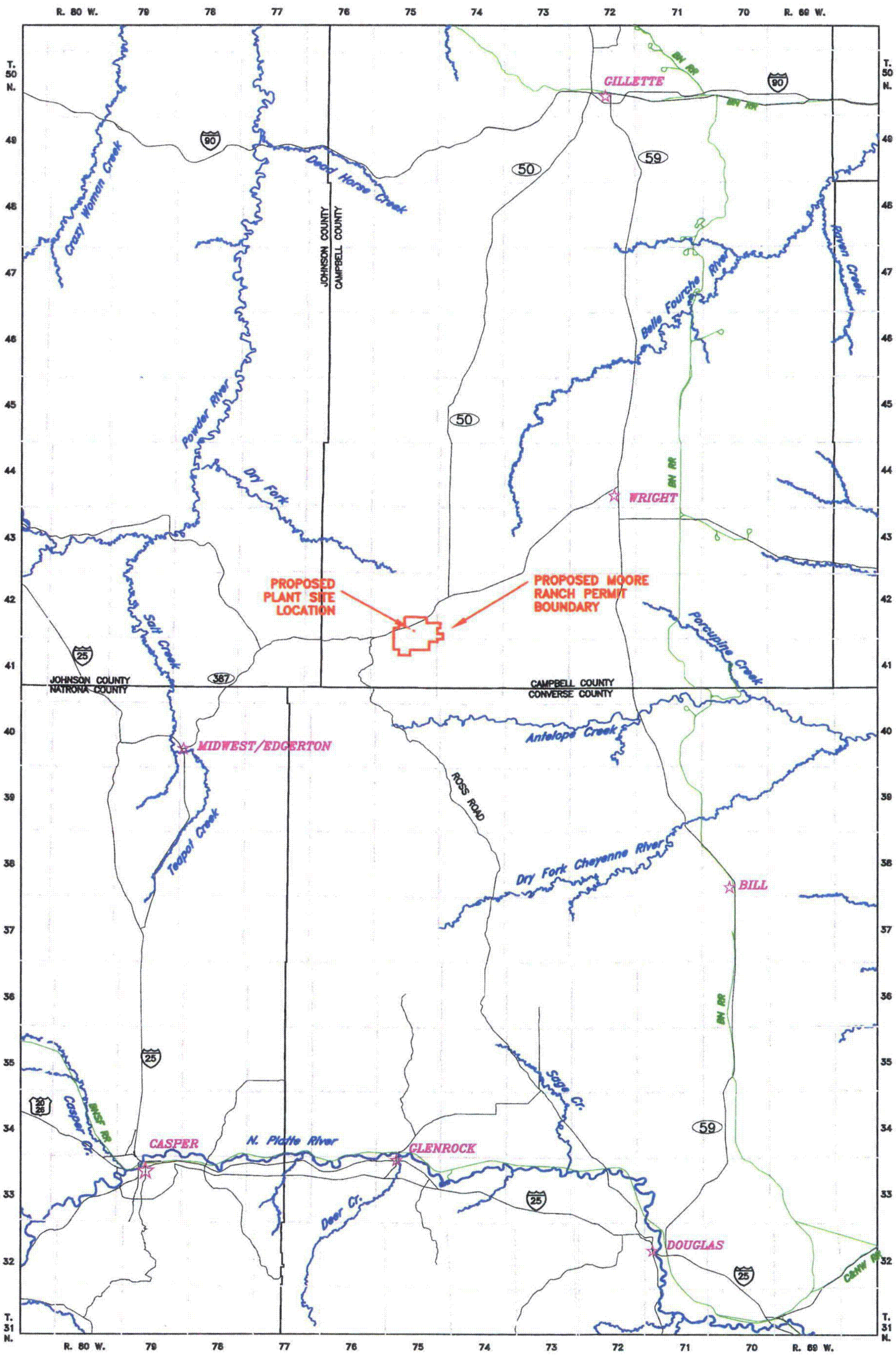
## 2.1 SITE LOCATION AND LAYOUT

The location of the proposed Moore Ranch Uranium Project is in Township 42 North, Range 75 West, Sections 26, 27, 33, 34, 35, 36 and Township 41 North, Range 75 West, Sections 1, 2, 3, and 4, and Township 42 North, Range 74 West, Section 31. Figure 2.1-1 shows the general location of the site in the Powder River Basin area in relation to surrounding population centers, interstates and highways, and County boundaries.

Access to the site from the east is on State Highway 59 or State Highway 50 to State Highway 387. Access from the west is from I-25 to State Highway 259 to State Highway 387. The main access road to the plant facilities and wellfields is located off Highway 387 in T42N, R75W, Section 27. The access road runs south through Section 34 and forks to the east through Section 35 and also continues south through the permit boundary. This existing access road will provide the primary access to all currently planned wellfields and facilities. Secondary roads for wellfield headerhouses and facility access will fork off of the existing primary access road.

The maps used in this section and other sections of this application were derived from USGS 7.5 minute topo quad maps from Topo Depot® software and geo spatial data from the Wyoming Geographic Information Science Center. These are CAD/GIS drawings where each road, stream, and contour line are individual entities. This base map was then used for each of the figures prepared for this document with the addition of the pertinent information for that figure.

Figure 2.1-2 shows the general topography, project site layout, and Restricted Areas for the license area including the Central Plant, Warehouse/Shop, and Office building areas, the potential mine unit boundaries. Other site right of ways such as electrical transmission lines, water pipelines, and oil and gas pipelines are shown on Figure 7.2-1 in Section 7.2. Drainage, surface water features, and waterways are shown on Figure 2.7.1-1 in Section 2.7.



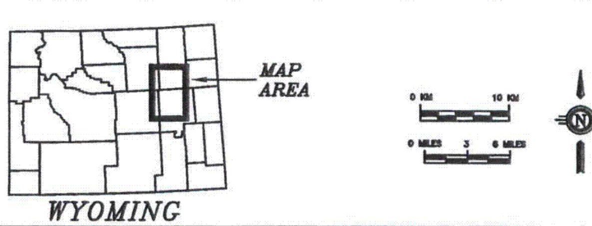




FIGURE 2.1-1

**ENERGY METALS CORPORATION, US**

Casper, WY

| REVISIONS | | |
|---|---|---|
| NO. | DATE | BY |
| 1 | 07/16/07 | JT |

**MOORE RANCH URANIUM PROJECT**

**SITE LOCATION MAP**

PORTIONS OF CONVERSE, NATRONA, JOHNSON & CAMPBELL COUNTIES

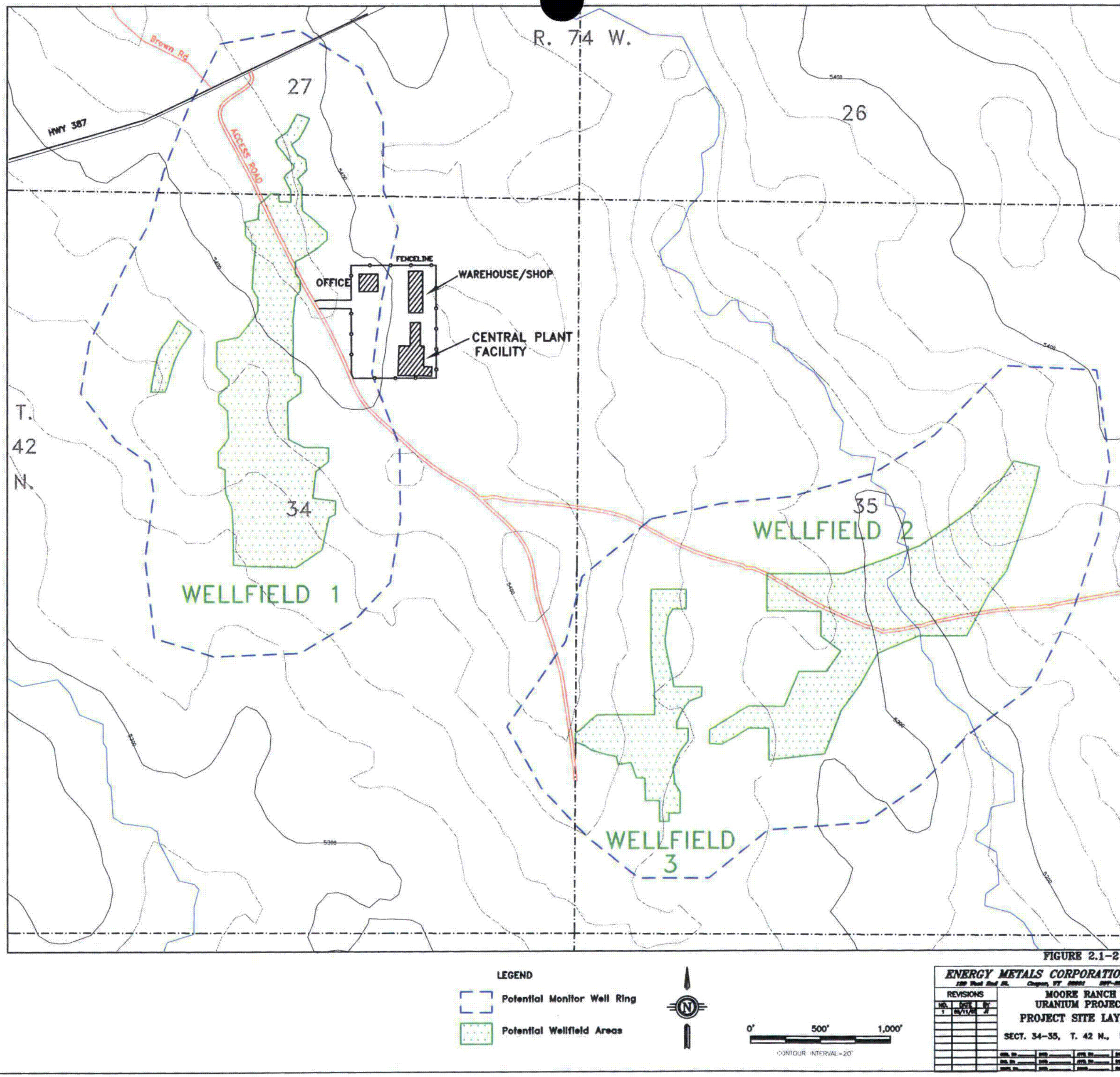



FIGURE 2.1-2

ENERGY METALS CORPORATION, US

REVISIONS

MOORE RANCH
URANIUM PROJECT
PROJECT SITE LAYOUT

SECT. 34-35, T. 42 N., R. 75 W.

## 2.2 USES OF ADJACENT LANDS AND WATERS

The information in this section provides relevant data concerning the physical, ecological, and social characteristics of the proposed Moore Ranch License Area (License Area), and the surrounding environs for uranium in-situ mining.

This section examines the nature and extent of present and projected land and water use and trends in population or industrial patterns. Preliminary data were obtained from several sources followed by field studies to collect on-site data to check land uses.

NRC guidance contained in NUREG 1569 (NRC 2003) requires review and discussion of land and water use in the License Area, and within a 2.0-mile radius (review area) surrounding the License Area. Land use within the review area is illustrated on Figure 2.2-1.

### 2.2.1 General Setting

The License Area is located in southwest Campbell County, Wyoming. Figure 2.2-1 shows land use in the general location of the proposed Moore Ranch License Area. Table 2.2-1 provides a description of the land use types depicted on Figure 2.2-1.

State Highway 387 provides access to the project area from the Towns of Midwest and Edgerton to the west and the Town of Wright to the northeast of the License Area. Interstate 25 provides access to State Highway 387 from the south and west of the License Area.

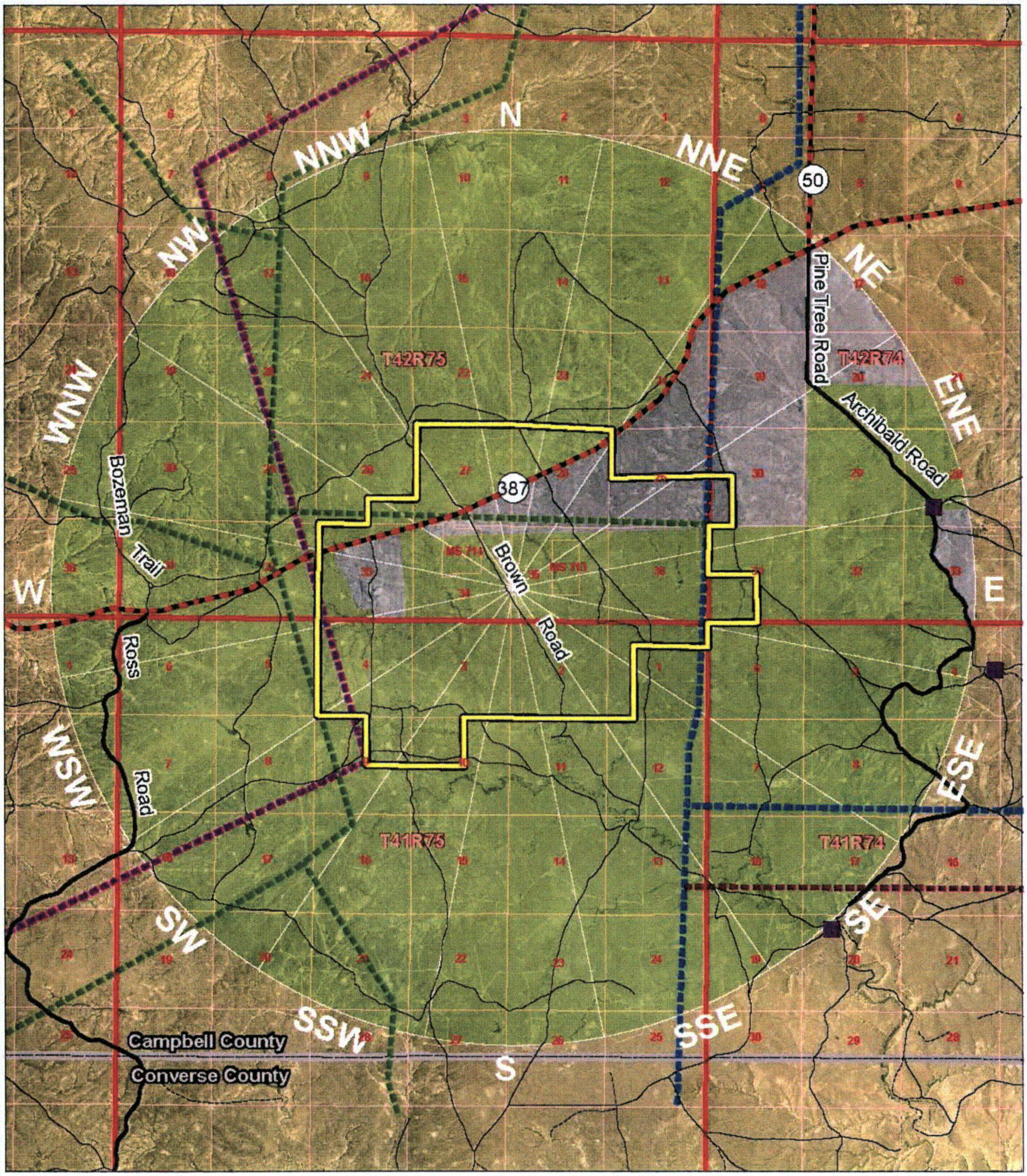
### 2.2.2 Land Use

Land use within the Moore Ranch License Area and a 2.0-mile review area around the License Area is illustrated on Figure 2.2-1. Table 2.2-1 describes the land use types depicted on Figure 2.2-1.

Table 2.2-2 presents land uses in 22 1/2° sectors centered on each of the 16 compass points. These sectors radiate out from the geographic center of the License Area. The total areas of the sectors vary because of the irregular site boundary. Rangeland is the primary land use within the License Area and within the surrounding 2.0-mile area. Oil and gas production facilities and infrastructure are located on rangeland land uses throughout the review area. The review area also contains pastureland to the west of the License Area. There are no other land uses that occur within the License Area and the surrounding 2.0-mile area.

**Table 2.2-1 Land Use Definitions**

| Land Use | Definition |
|---|---|
| Pastureland (P) | Land used primarily for the long-term production of adapted, domesticated forage plants to be grazed by livestock or occasionally cut and cured for livestock feed. |
| Rangeland (R) | Land, roughly west of the 100th meridian, where the natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs; which is used wholly or partially for the grazing of livestock. This category includes wooded areas where grasses are established in clearings and beneath the overstory. |




**Legend**

- Moore Ranch Project Area
- Residence
- Pasture
- Rangeland

0 1 2 Miles

**Pipelines**

**Owner, Product**

- Belle Fourche, Crude Oil
- Kinder Morgan, Natural Gas
- Thunder Creek, Natural Gas
- Western Gas, Natural Gas

ARCADIS

ENERGY METALS CORP.

**FIGURE 2.2-1**
**MOORE RANCH**
**LAND USE**

Project Number: CO001252.0001.0002

**Table 2.2-2 Land Use of the Proposed Moore Ranch License Area and within a 2.0-Mile (3.3-km) Radius of the License Area Boundary**

| Compass Sector | Land Use within License Area (in acres) | | Land Use within 2.0-Mile Buffer Surrounding License Area (in acres) | | Total |
|---|---|---|---|---|---|
| | P | R/I | P | R/I | |
| NORTH | 95.7 | 266.0 | 0.0 | 2,473.6 | 2,835.3 |
| NNE | 208.7 | 199.3 | 0.5 | 2,426.7 | 2,835.3 |
| NE | 287.9 | 89.6 | 2,083.7 | 374.1 | 2,835.3 |
| ENE | 328.5 | 347.9 | 805.7 | 1,353.2 | 2,835.3 |
| EAST | 0.0 | 678.7 | 218.4 | 1,938.3 | 2,835.3 |
| ESE | 0.0 | 368.6 | 0.0 | 2,466.6 | 2,835.3 |
| SE | 0.0 | 357.1 | 0.0 | 2,478.2 | 2,835.3 |
| SSE | 0.0 | 277.0 | 0.0 | 2,558.3 | 2,835.3 |
| SOUTH | 0.0 | 233.1 | 0.0 | 2,602.2 | 2,835.3 |
| SSW | 0.0 | 452.5 | 0.0 | 2,382.8 | 2,835.3 |
| SW | 0.0 | 618.4 | 0.0 | 2,216.8 | 2,835.3 |
| WSW | 11.6 | 599.8 | 0.0 | 2,223.9 | 2,835.3 |
| WEST | 198.9 | 316.7 | 0.0 | 2,319.6 | 2,835.3 |
| WNW | 93.5 | 345.8 | 0.0 | 2,396.0 | 2,835.3 |
| NW | 54.6 | 240.9 | 0.0 | 2,539.8 | 2,835.3 |
| NNW | 64.7 | 357.1 | 0.0 | 2,413.5 | 2,835.3 |
| TOTAL | 1,344.0 | 5,748.7 | 3,108.2 | 35,163.7 | 45,364.7 |

[1]22 $^{1}/_{2}$° sectors centered on each of the 16 compass points
[2]See Table 2.2-1 for an explanation of land use types: P = pastureland; R = rangeland.

Industrial and Mining land uses are sub-categories of the dominant rangeland land use within the License Area and the surrounding 2.0-mile review area. The Industrial and Mining land use sub-categories consists of ongoing oil and natural gas production facilities located throughout rangeland that is also used for grazing.

In 2006, an average of 50,000 livestock were reported for Campbell County (NASS 2007). Native grasslands are used for grazing within the License Area and the surrounding 2.0-mile area, and for cut hay in the northeast part of the review area. In 2005, cash receipts for livestock sales totaled $99.8 million in Campbell County. Table 2.2-3 shows the 2006 livestock inventory for Campbell County.

**Table 2.2-3 2006 Livestock Inventory for Campbell County**

| Type of Livestock | Number | Percent of Total | Animal Units [a] | |
|---|---|---|---|---|
| | | | Pounds (000s) | Percent |
| Beef Cows | 49,950 | 39.0 | 49,950 | 47.3 |
| | | | | |
| Cows | 50,000 | 39.1 | 50,000 | 47.4 |
| | | | | |
| Breeding Sheep & Lambs | 28,000 | 21.9 | 5600 | 5.3 |
| | | | | |
| Total animals | 127,950 | 100.0 | 105,550 | 100.0 |

Notes:
[a] Animal unit conversions:
1 cow = 1,000 lb.
1 sheep = 200 lb.
1 animal unit = 1,000 lb.
Source: USDA 2006.

Recreational lands also are present in Campbell, Natrona, Johnson, Converse, Niobrara, and Weston Counties within 50-miles of the License Area (Table 2.2-4). Recreational opportunities provided by federal and state lands in the county have become an increasingly important component of the local economy. The regional setting of the License Area provides broad, panoramic prairie landscapes, which provide a setting for a variety of outdoor recreational activities. Major attractions include the Thunder Basin National Grassland, several state historic sites, and the historic Bozeman Trail.

There is no recreational use of the License Area or the surrounding 2.0-mile area, as all of the land is privately owned; however, opportunities for developed and dispersed recreation exist on federal and state lands throughout the five counties that are within the 50-mile radius of the License Area. Developed recreational facilities, such as campgrounds, are generally limited to private lands in or near to larger communities within the 50-mile radius. These communities provide a variety of municipal and private recreational facilities including golf courses, rodeo grounds, ball parks, and swimming pools.

The region within the 50-mile radius of the License Area includes several special recreation management areas on public and private lands (Table 2.2-4). Limited developed recreation facilities are also located in special management areas on Bureau of Land Management (BLM)-administered public lands.

**Table 2.2-4 Recreational Areas within 50-miles of the Moore Ranch License Area**

| Name of Recreational Facility | Managing Agency | Distance From Moore Ranch License Area (miles) |
|---|---|---|
| South Bighorn/Red Wall Back Country Byway | Wyoming Department of Transportation | 41.0 |
| Bozeman Trail | Various agencies | 1.0 |
| Thunder Basin National Grassland | US Forest Service | 14.0 |
| Pumpkin Buttes | BLM – Buffalo Field Office | 10.0 |
| Fort Reno Historic Site | Wyoming State Parks and Cultural Resources Department | 27.0 |

Source: DeLorme Maps, 2003

Based on a site reconnaissance conducted in May 2007 and a 2006 aerial photo of the License Area, there are no occupied housing units in the License Area. Table 2.2-5 shows the distance to the nearest residence and to the nearest site boundary from the center of the site for each 22 1/2° sector centered on each of 16 compass points for the License Area. The nearest resident is 4.3 miles to the east of the License area as shown on Figure 2.2-1.

**Table 2.2-5 Distance to Nearest Residence and Site Boundary from Center of Moore Ranch License Area for Each Compass Sector within the 2.0-Mile Radius**

| Compass Sector[1] | Nearest Residence (miles) | Nearest Site Boundary (feet/mile) |
|---|---|---|
| North | 14.2 | 8,050/1.5 |
| North-Northeast | 8.5 | 8,700/1.6 |
| Northeast | 9.0 | 7,730/1.5 |
| East-Northeast | 15.0 | 9,180/1.7 |
| East | 4.3 | 10,620/2.0 |
| East-Southeast | 25.0 | 10,300/2.0 |
| Southeast | 5.0 | 7,407/1.4 |
| South-Southeast | 9.3 | 8,700/1.6 |
| South | 8.3 | 7,730/1.5 |
| South-Southwest | 9.0 | 8,050/1.5 |
| Southwest | 26.5 | 11,100/2.1 |
| West-Southwest | 8.5 | 11,300/2.1 |
| West | 8.0 | 10,600/2.0 |
| West-Northwest | 12.0 | 7,400/1.4 |
| Northwest | 10.2 | 8,050/1.5 |
| North-Northwest | 8.0 | 9,000/1.7 |

[1] $22^1/_2$° sectors centered on each of the 16 compass points

### 2.2.2.1 Oil and Gas Development

The License Area is located within the Powder River Basin, which contains major deposits of coal bed methane (CBM) and other petroleum resources. Several oil and gas leases are located in the License Area. Both the License Area and the 2-mile buffer contain producing oil and gas wells, which are drilled to the Fort Union Formation. The administering agency for split estate minerals (private surface and federal subsurface minerals) is the Buffalo Field Office of the Bureau of Land Management. Table 2.2-6 lists the leases that are located partially or entirely within the License Area and the surrounding 2-mile buffer, and provides the 2006 annual gas and oil production total for each lease.

The Powder River Basin has been developed since the mid-1980's for the recovery of CBM. With advancements in technology, development and production of CBM has been increasing substantially since the mid-1990s. Development has been centered in all or parts of Campbell, Converse, Johnson, and Sheridan counties. The target coal zones are contained in the Fort Union formation.

CBM recovery methods, environmental impacts, existing CBM recovery facilities, and cumulative environmental impacts of existing CBM development and the Moore Ranch Project are discussed in detail in Section 7.2.9.

**Table 2.2-6 Oil and Gas Leases in the Moore Ranch License Area[1]**

| License Area | | | | 2-Mile Buffer | | | |
|---|---|---|---|---|---|---|---|
| Lease | # Wells | 2006 Oil Production (Bbls) | 2006 Gas Production (Mcf) | Lease | # Wells | 2006 Oil Production (Bbls) | 2006 Gas Production (Mcf) |
| WYW 027112 | 13 | 8,893 | 65,668 | WYW 031705 | no records | | |
| WYW 029019 | no records | | | WYW 062365 | no records | | |
| WYW 0311966 | 3 | 5,476 | 41,107 | WYW 111602 | no records | | |
| WYW 128092 | no records | | | WYW 111608 | 3 | 0 | 99,673 |
| WYW 144498 | 21 | 0 | 618,241 | WYW 115668 | 2 | 0 | 53,819 |
| WYW 145151 | 1 | 0 | 22,162 | WYW 130597 | 8 | 0 | 344,605 |
| | | | | WYW 130607 | no records | | |
| | | | | WYW 131506 | no records | | |
| | | | | WYW 139088 | 2 | 0 | 88,989 |
| | | | | WYW 139089 | 2 | 0 | 75,692 |
| | | | | WYW 139669 | 11 | 0 | 293,362 |
| | | | | WYW 141222 | 11 | 0 | 470,219 |
| | | | | WYW 141654 | 2 | 0 | 78,846 |
| | | | | WYW 145150 | 13 | 0 | 469,267 |
| | | | | WYW 145571 | 19 | 0 | 318,859 |
| | | | | WYW 145572 | 3 | 0 | 5,693 |
| | | | | WYW 147285 | 1 | 0 | 36,885 |
| | | | | WYW 147289 | 10 | 0 | 368,745 |
| | | | | WYW 152618 | no records | | |
| | | | | WYW 0258523 | 7 | 14,652 | 97,156 |
| | | | | WYW 0263740 | 1 | 667 | 11,128 |
| | | | | WYW 0266627 | 1 | 0 | 0 |
| | | | | WYW 0271123 | 2 | 3,458 | 4,419 |
| | | | | WYW 0271124 | 9 | 1,574 | 56,951 |
| | | | | WYW 0275169 | 13 | 1,270 | 275,612 |
| | | | | WYW 0297109 | 1 | 1,751 | 10,725 |
| | | | | WYW 0314361 | 17 | 3,899 | 12,853 |
| | | | | WYW 0525203 | no records | | |

[1]Each lease is listed only once in the table; however, there is considerable overlap in the lease area boundaries within the License Area, the 2-mile buffer, and areas outside the License Area and the buffer.

Source: WYOGCC 20

### 2.2.2.2 Aesthetics

The Moore Ranch License Area is located on flat to rolling grasslands that are typical landscapes in the Powder River Basin. The License Area landscape is rural in character, with minor industrial development from oil and gas extraction activities. The landscape colors are dominated by tan, gold, and green vegetation and tan soils. As the License Area has been used historically for grazing and oil development, it is unlikely that any undisturbed area exists within the proposed License Area. Human influence is evident in existing grazing activities and facilities (stock tanks, fences), oil production facilities, natural gas production facilities, and infrastructures that support these activities. Oil and gas field infrastructure in the License Area and the surrounding 2.0-mile review area includes access roads, overhead electric distribution lines, and cleared rights-of-way for underground utilities, which are generally found along access roads.

#### 2.2.2.3 Transportation and Utilities

The primary transportation route to the License Area from nearby communities is on State Highway 387, which connects the License Area to regional population and economic centers along Interstate 25 to the west. The City of Gillette is located approximately 50 miles northeast of the License Area on State Highway 59, which connects with State Highway 387 at Wright. Annual Average Daily Traffic counts along the 13.06-mile segment of State Highway 387 between the Campbell/Johnson county line and the State Highway 387 junction is 1,110 vehicles (WYDOT 2005). Several private access roads extend south from State Highway 387 to access existing agricultural, as well as oil and gas facilities in the License Area. None of the existing roads in the License Area provide access to residences or other public destinations.

As shown on Figure 7.2-1, the project area contains a significant amount of overhead power lines associated with CBM development. As a result, electrical power will be available for Moore Ranch operations without requiring large-scale installation of new electrical transmission lines. Some large scale oil and gas pipelines exist just west of the proposed project boundaries as shown in Figure 2.2-1. The Moore Ranch Project will not have an impact on these lines due to the distance from the project. Smaller pipelines and utility lines exist in the project area as a result of CBM operations. Interaction with this existing infrastructure is discussed in further detail in Section 7.

#### 2.2.2.4 Fuel Cycle Facilities

The United States Nuclear Regulatory Commission website (NRC 2007) provides the locations of all source material facilities in the United States, including fuel cycle facilities and uranium mills. The website was reviewed to identify the location of fuel cycle facilities and uranium mills within 50 miles (80-km) of the proposed Moore Ranch License Area. No fuel cycle facilities were located within 50 miles of the License Area. The nearest facility is the AREVA NP, Inc. uranium fuel fabrication facility, located in Richland, Washington (U.S. NRC 2007).

Several Source Material Licenses for in-situ uranium projects occur within a fifty mile radius of the Moore Ranch Project as shown on Figure 2.2-2. These sites are listed below:

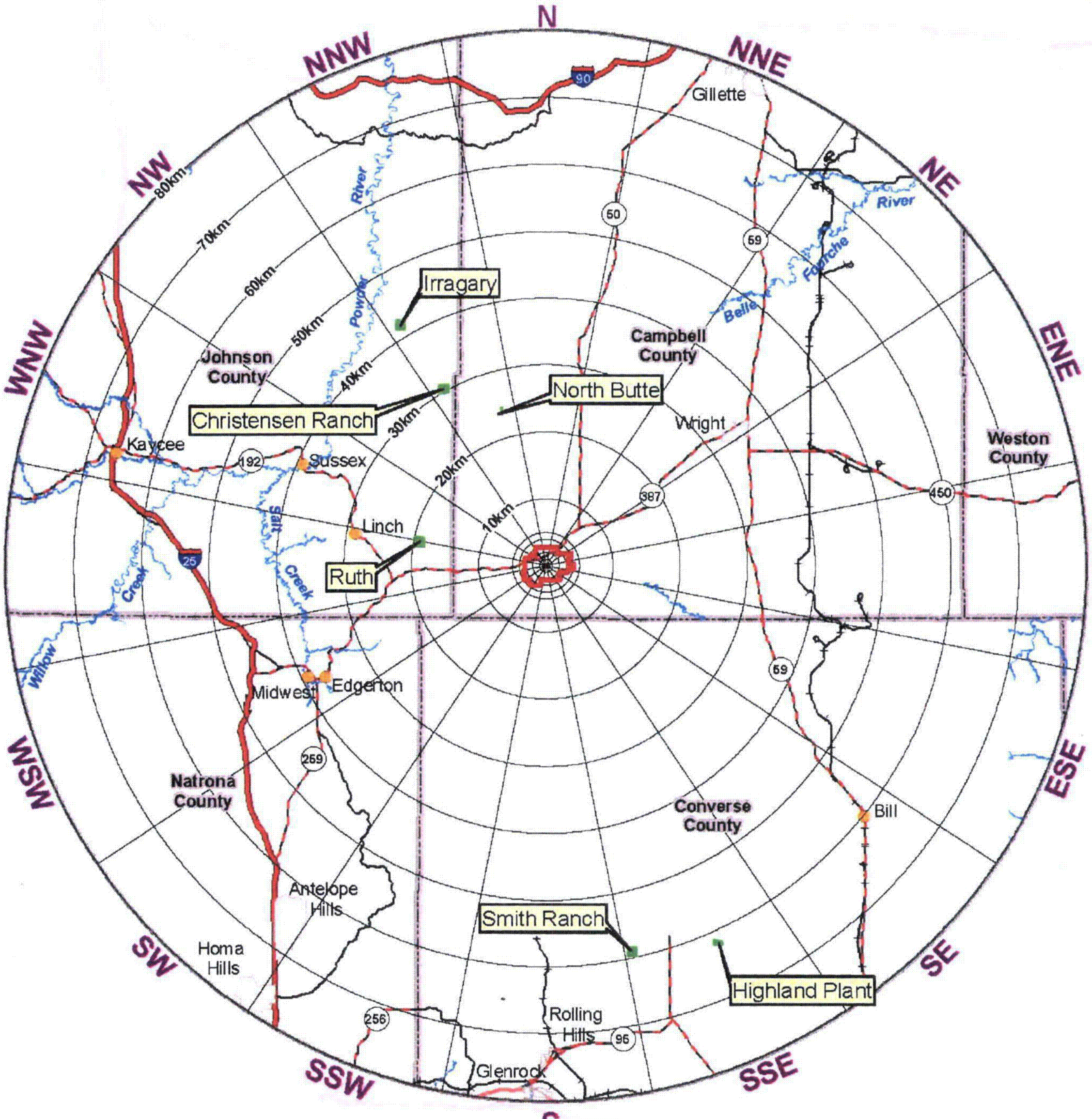
- Smith Ranch-Highland Uranium Project (SUA-1548, Power Resources, Inc.)- The Smith Ranch plant is located in T36N, R74W, Section 36 (59 km SSE of the proposed Moore Ranch Project) and is operational. The Highland plant is located in T36N, R72W, Section 29 (62 km SSE of the proposed Moore Ranch Project) and is currently on standby status. Three satellite ion exchange facilities are in operation and two more are planned for construction in the Smith Ranch-Highland license area.

- Christensen Ranch-Irigaray (SUA-1341 Cogema Mining Co.) - The Christensen Ranch site is located in Johnson County, T44N, R76W, Section 7 (30 km NNW of the proposed Moore Ranch Project) and the Irigaray satellite is located in Johnson County, T45N, R77W, Section 9 (42 km NNW of the proposed Moore Ranch Project). Both of these sites are on standby status.

- North Butte Project (SUA-1548, Power Resources Inc.) - The North Butte Project is located in Campbell County, T44N, R76W, Section 24 (25 km NNW of the proposed Moore Ranch Project). This is a satellite project for the Smith Ranch-Highland project and is not constructed or in operation.

- Ruth Project (SUA-1548, Power Resources, Inc.)- The Ruth Project is located in Johnson County, T42N, R77W, Section 23 (20 km W/WNW of the proposed Moore Ranch Project). This is a satellite project for the Smith Ranch-Highland project and is not constructed or in operation.

The nearest operational in-situ plant is the Smith Ranch facility, which is the only currently producing facility in Wyoming. The facility is in Converse County about 36 miles south-southeast of the Moore Ranch License Area (U.S. NRC 2007, Wise Uranium 2007). The Christensen Ranch site, located about 17 miles northwest of the License Area, has submitted an application in 2007 to restart the in-situ recovery operation.




## Legend

Moore Ranch Project Area

Uranium Source Materials Locations

0 5 10 20 Miles

ARCADIS

ENERGY METALS CORP.

*FIGURE 2.2-2*
*MOORE RANCH PROJECT*
*URANIUM SOURCE MATERIALS PROJECTS*
*WITHIN 80 KILOMETERS*

Project Number: CO001252.0001.0002

### 2.2.3 Uses of Adjacent Waters

The information in this section provides relevant data concerning the physical, ecological, and social characteristics of the proposed Moore Ranch License Area (License Area) and the surrounding environs for uranium in-situ mining.

This section examines the nature and extent of present and projected water use in the License Area. Preliminary data were obtained from several sources followed by field studies to collect on-site data.

NRC guidance in NUREG 1569 (NRC 2003) requires review and discussion of water use in the License Area and within a 2-mile radius (review area) surrounding the License Area. Water use within the review area is illustrated on Figure 2.2-3.

#### 2.2.3.1 Surface Water

The Moore Ranch License Area, as well as the western, southern, and eastern portions of the 2-mile radius review area (located in Campbell County, Wyoming) are drained by Ninemile Creek, an intermittent stream which flows through the far southern portion of the property in a southeasterly direction, within the Antelope Basin, Hydrologic Unit Code (HUC) 10120101 (US EPA 2007) (Figure 2.2-4). Simmons Draw, an intermittent stream, flows through the License Area from the northwest to the southeast and joins with Ninemile Creek just south of the License Area near the Van Gordon Ranch. Another unnamed intermittent stream flows through the center of the License Area from north to south and converges with Ninemile Creek on the south side near the Van Gordon Ranch. Pine Tree Draw is an intermittent stream located in the eastern portion of the License Area and flows from north to south, joining with Ninemile Creek southeast, just upstream from Ninemile Ranch. Pine Tree Draw is composed of three distinct branches within the License Area. The most easterly branch of Pine Tree Draw is fed by Pine Tree Spring, which is located at an elevation of 5,244 feet above mean sea level (amsl). Ninemile Creek joins with Antelope Creek southeast of the License Area in Converse County, WY about 8 miles downstream. Antelope Creek eventually flows easterly through Thunder Basin National Grassland to its confluence with the Cheyenne River in eastern Wyoming (USGS 1977). The Antelope Basin drains a total of 1,036 square miles and is part of the greater Cheyenne River Basin, which is part of the Northeastern Wyoming River Basin area (US EPA 2007 and HKM et al. 2002).

### 2.2.3 Uses of Adjacent Waters

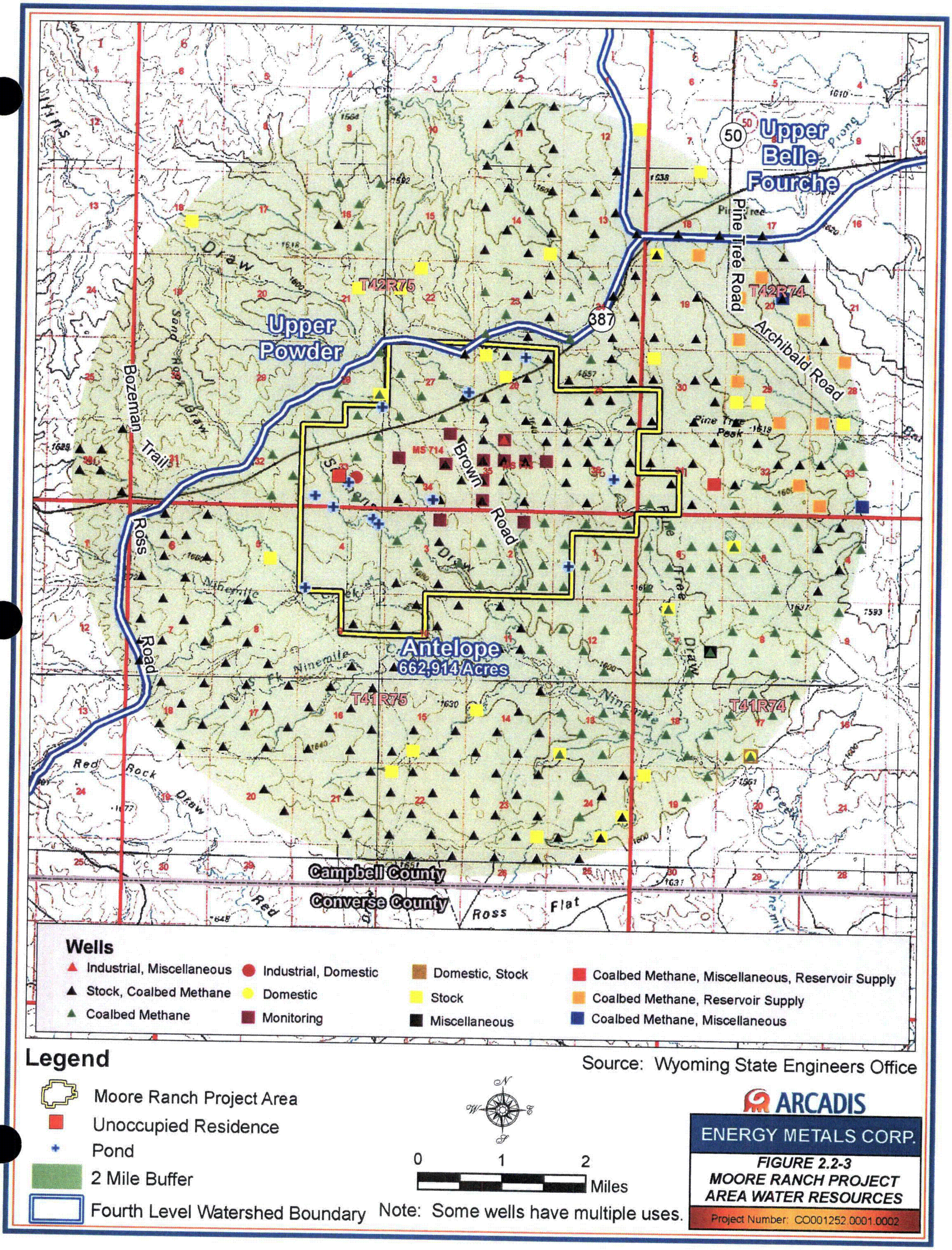
The information in this section provides relevant data concerning the physical, ecological, and social characteristics of the proposed Moore Ranch License Area (License Area) and the surrounding environs for uranium in-situ mining.

This section examines the nature and extent of present and projected water use in the License Area. Preliminary data were obtained from several sources followed by field studies to collect on-site data.

NRC guidance in NUREG 1569 (NRC 2003) requires review and discussion of water use in the License Area and within a 2-mile radius (review area) surrounding the License Area. Water use within the review area is illustrated on Figure 2.2-3.

#### 2.2.3.1 Surface Water

The Moore Ranch License Area, as well as the western, southern, and eastern portions of the 2-mile radius review area (located in Campbell County, Wyoming) are drained by Ninemile Creek, an intermittent stream which flows through the far southern portion of the property in a southeasterly direction, within the Antelope Basin, Hydrologic Unit Code (HUC) 10120101 (US EPA 2007) (Figure 2.2-4). Simmons Draw, an intermittent stream, flows through the License Area from the northwest to the southeast and joins with Ninemile Creek just south of the License Area near the Van Gordon Ranch. Another unnamed intermittent stream flows through the center of the License Area from north to south and converges with Ninemile Creek on the south side near the Van Gordon Ranch. Pine Tree Draw is an intermittent stream located in the eastern portion of the License Area and flows from north to south, joining with Ninemile Creek southeast, just upstream from Ninemile Ranch. Pine Tree Draw is composed of three distinct branches within the License Area. The most easterly branch of Pine Tree Draw is fed by Pine Tree Spring, which is located at an elevation of 5,244 feet above mean sea level (amsl). Ninemile Creek joins with Antelope Creek southeast of the License Area in Converse County, WY about 8 miles downstream. Antelope Creek eventually flows easterly through Thunder Basin National Grassland to its confluence with the Cheyenne River in eastern Wyoming (USGS 1977). The Antelope Basin drains a total of 1,036 square miles and is part of the greater Cheyenne River Basin, which is part of the Northeastern Wyoming River Basin area (US EPA 2007 and HKM et al. 2002).


Upper Belle Fourche
Upper Powder
Pine Tree Road
Archibald Road
Bozeman Trail
Ross Road
Brown Road
T42R75
T42R74
T41R75
T41R74
Antelope
662,914 Acres
Campbell County
Converse County
387
50
Wells
Industrial, Miscellaneous
Stock, Coalbed Methane
Coalbed Methane
Industrial, Domestic
Domestic
Monitoring
Domestic, Stock
Stock
Miscellaneous
Coalbed Methane, Miscellaneous, Reservoir Supply
Coalbed Methane, Reservoir Supply
Coalbed Methane, Miscellaneous
Legend
Moore Ranch Project Area
Unoccupied Residence
Pond
2 Mile Buffer
Fourth Level Watershed Boundary
Source: Wyoming State Engineers Office
0
1
2
Miles
Note: Some wells have multiple uses.
ARCADIS
ENERGY METALS CORP.
FIGURE 2.2-3
MOORE RANCH PROJECT AREA WATER RESOURCES
Project Number: CO001252.0001.0002

About nine small ponds are located within the License Area (Figure 2.2-3). The ponds are located on ephemeral streams including Ninemile Creek, Simmons Draw, an unnamed stream, and Pine Tree Draw. Ponds are used to supply range and pasture animals with drinking water or may be used for holding water discharged from coal bed methane and other oil and gas mining operations.

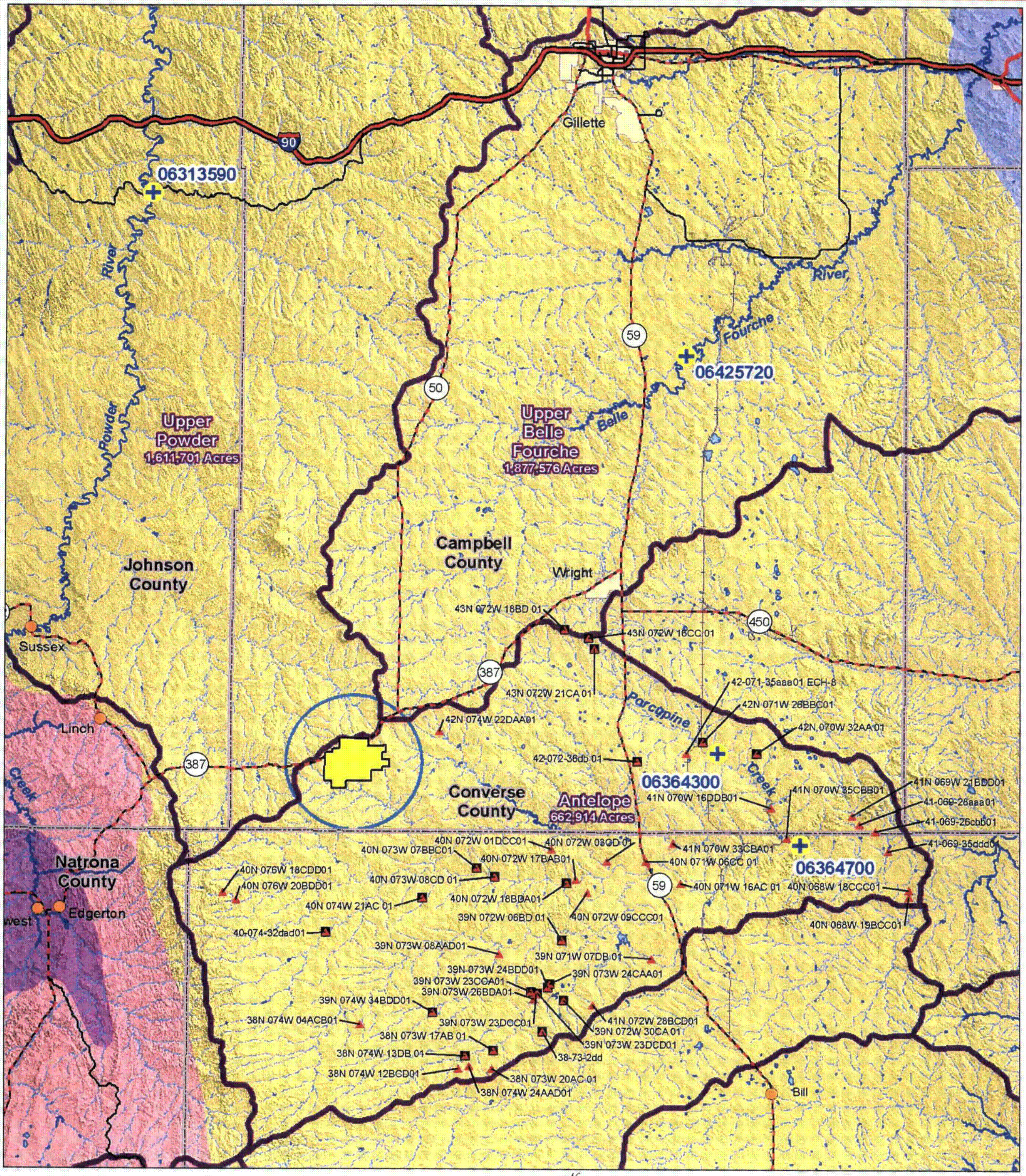
The northern/northwestern portion of the 2-mile review area drains to the Upper Powder River Basin (HUC 10090202) via Collins Draw and Cottonwood Creek (Figure 2.2-3). Collins Draw and Cottonwood Creek flow northward and join with the Dry Powder River in Johnson County, WY northwest of the License Area. The Dry Powder River flows northwesterly to its confluence with the Powder River just north of Sussex, WY. The total drainage area of the Upper Powder Basin is 2,518 square miles (US EPA 2007).

The northeasternmost portion of the 2-mile review area drains to the Belle Fourche River and the Upper Belle Fourche Basin, HUC 10120201, which has a drainage area of 2,934 square miles (Figure 2.2-3) (US EPA 2007). In the upper potion of the Belle Fourche River is an intermittent river which eventually joins with the Cheyenne River east of the South Dakota boundary. The Cheyenne River joins the Missouri River in South Dakota.

Elevations near the License Area and its surrounding 2-mile review area are approximately 5,500 feet. Climate in the area is arid, typical of a high desert area, with low annual precipitation (13 inches/year) and high evaporation rates. Hydrographs for streams in the upper portions of the Antelope, Upper Belle Fourche, and Upper Powder River watersheds peak during snowmelt in the late spring/early summer. Summer thunderstorms also influence smaller hydrograph peaks.

Surface Water Quantity

Surface water data for the Antelope Creek Basin (HUC 10120101) are scarce. No stream flow data are available for drainages located within the License Area or within the 2-mile review area. One U.S. Geological Survey (USGS) stream gage on Antelope Creek near Teckla, WY (USGS 06364700) is located southwest and downstream of the License Area (Figure 2.2-4). In the Upper Powder River Basin (HUC 10090202), which receives drainage from the northwest portion of the 2-mile review area, a USGS stream gage (USGS 06313590) is located above Burger Draw near Buffalo, WY. The Upper Belle Fourche River Basin (HUC 10120201), which receives a small portion of the drainage from the northeastern tip of the 2-mile review area, has a USGS stream gage located below Rattlesnake Creek near Piney, WY.




## Legend

- Project Area
- USGS Stream Gage Location
- Fourth Level Sub-watershed Boundary
- County Boundary
- Two Mile Buffer

0 5 10 20 Miles

- USGS Groundwater Well
- USGS Groundwater Monitoring Well

ARCADIS

ENERGY METALS CORP.

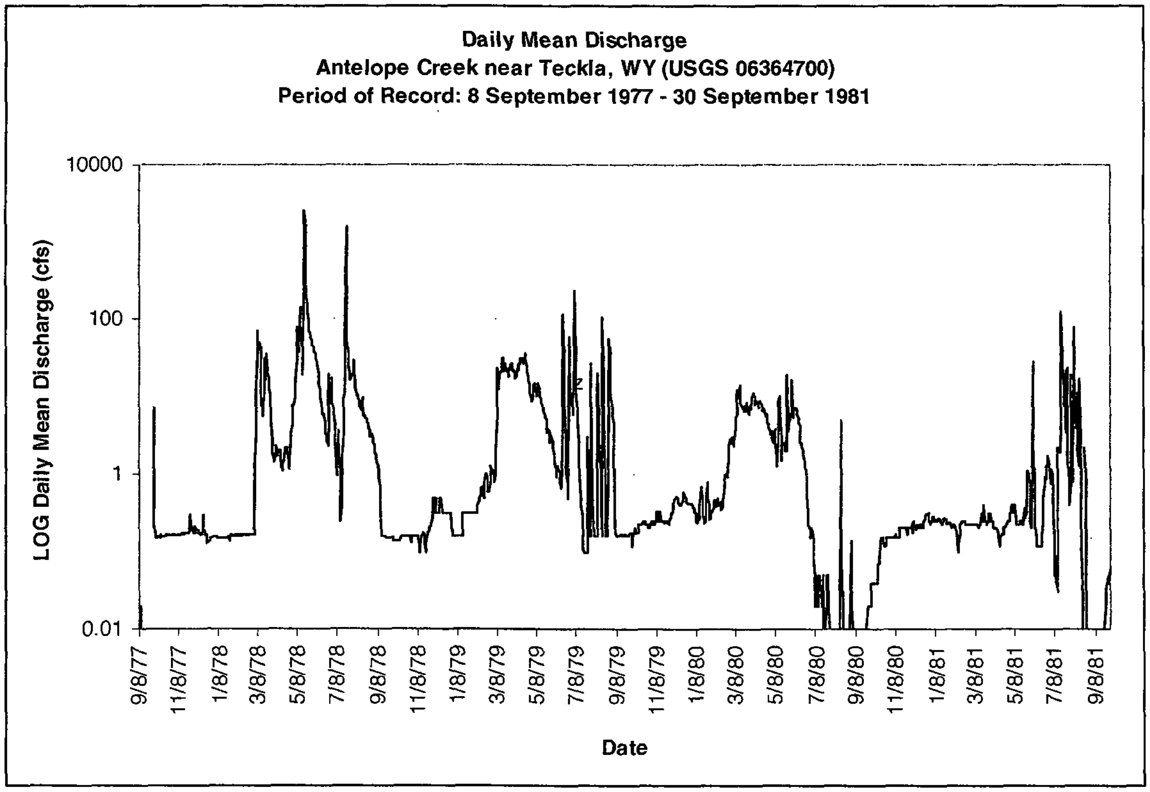
**FIGURE 2.2-4**
**MOORE RANCH PROJECT**
**REGIONAL WATER RESOURCES**

Project Number: CO001252.0001.0002

Streamflow data from these USGS gage sites were analyzed to describe water quantities that may be influenced from activities within the License Area (USGS 2007).

Available daily mean discharge data for Antelope Creek is limited to September of 1977 through September of 1981. Analysis of daily mean discharge for Antelope Creek near Teckla, WY (USGS 06364700) from during this period revealed an average of 9.8 cubic feet per second (cfs) and a median of 0.3 cfs. The maximum daily mean discharge of 2,560 cfs was recorded on May 18, 1978. Analysis of annual instantaneous peak discharge recorded from August 17, 1979 through August 5, 1981 revealed a peak flow of 1,760 cfs measured on August 17, 1979. Average peak flows were 836 cfs, ranging from 70 to 1,760 cfs, and the median peak flow was 836 cfs (USGS 2007) (Figure 2.2-5). Flood frequency data analysis was not possible due to the limited record of annual peak instantaneous data.

**Figure 2.2-5 Daily Mean Discharge for Antelope Creek near the Town of Teckla**

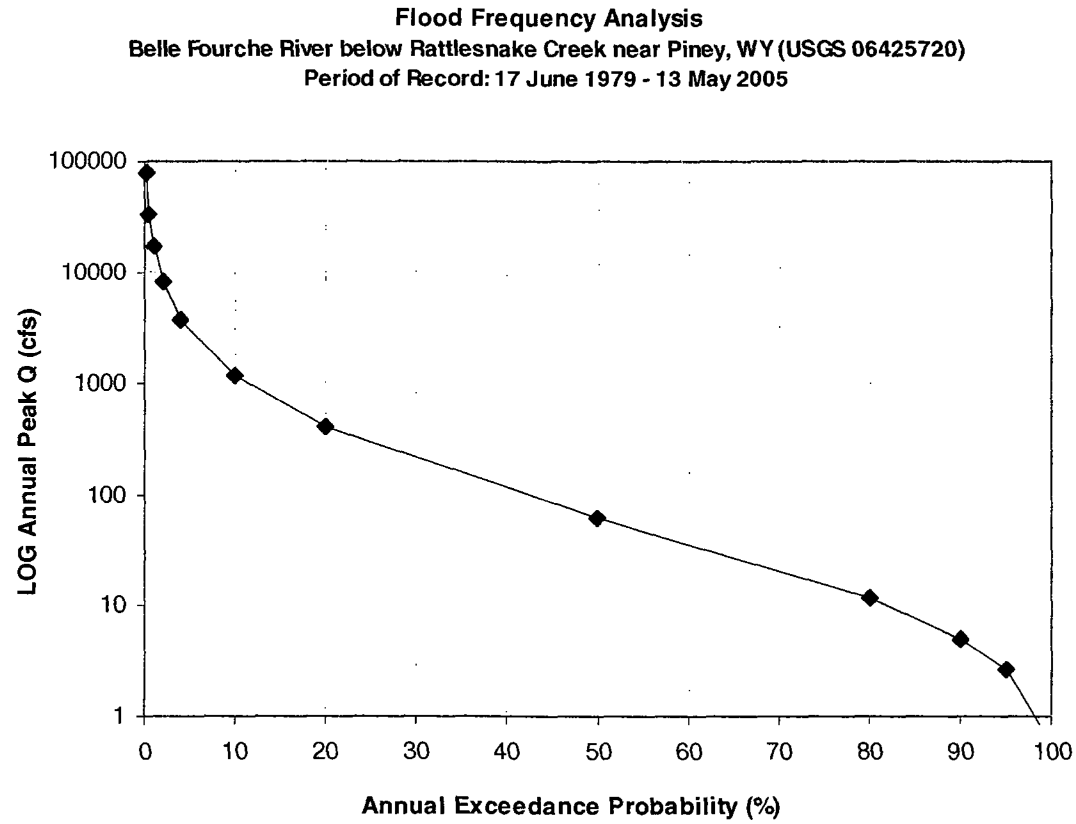



Analysis of daily mean discharge for the Powder River above Burger Draw near Buffalo, WY (USGS 06313590) from June 12, 2003 through June 28, 2007 revealed an average flow of 127 cfs and a median flow of 100 cfs. Daily mean discharge ranged from a minimum of 0.03 cfs to a maximum of 3,050 cfs, which occurred on May 7, 2007. Analysis of annual peak instantaneous discharge for the period of June 18, 2003 to May 12, 2005 revealed an average of 2,360 cfs and a median of 2,200 cfs. Annual instantaneous peaks flows ranged from 1,140 cfs to 3,740 cfs, which was recorded on May 12, 2005 (USGS 2007). Flood frequency data analysis was not possible due to the limited record of annual peak instantaneous data.

Analysis of daily mean discharge for the Belle Fourche River below Rattlesnake Creek near Piney, WY (USGS 06425720) revealed an average flow of 9.0 cfs and a median flow of 0.3 cfs. Daily mean discharge ranged from 0 cfs to 2,740 cfs, which was recorded on December 28, 2003. Analysis of annual instantaneous peak discharge from June 17, 1979 to May 13, 2005 indicated a mean peak flow of 357 cfs and a median peak flow of 36 cfs. Annual instantaneous peak discharges ranged from 4 cfs to 1,300 cfs, which was recorded on June 17, 1979 (USGS 2007).

Flood frequency analysis was performed using the USGS standard method, in which a log-Pearson Type III frequency distribution is fit to the logarithms of the peak flow cumulative distribution. Parameters of the log-Pearson Type III were estimated from the logarithmic peak flows (mean, standard deviation, and coefficient of skewness) with adjustments for low and high outliers, historic peaks and generalized skew (Riggs 1968). Log-Pearson III flood frequency analysis revealed a flood that has the probability of occurring once every 10 years, has a magnitude of about 1,100 cfs. Similarly, a flood that has the probability of occurring once every 100 years has a magnitude of 12,000 cfs (Figure 2.2-6).

**Figure 2.2-6 Flood Frequency Analysis for Belle Fourche River near Piney, Wyoming**




## Surface Water Quality

Water quality data were available from only one USGS stream gage (06364700) located on Antelope Creek near Teckla, WY from October 3, 1977 through September 7, 2005. Water quality data analyses revealed a mean temperature of 10.4 degrees Celsius (°C) and a range from 0 to 30 °C. Mean dissolved oxygen was 7.8 milligrams/Liter (mg/L) and ranged from 2.8 to 11.7 mg/L. Total nitrogen averaged 0.55 mg/L and ranged from 0.21 to 1.8 mg/L. Mean ammonia as nitrogen concentrations were 0.04 mg/L and ranged from 0 to 0.13 mg/L. Nitrite plus nitrate as nitrogen averaged 0.04 mg/L, with a range from 0 to 0.29 mg/L. Average phosphate was 0.03 mg/L and average selenium (water filtered) was 0.56 mg/L (USGS 2007).

EMC has conducted surface water quality sampling at 10 monitoring locations at the Moore Ranch site. Sampling was performed on a quarterly basis since the last quarter of 2006. A summary of the results for the water quality monitoring is presented in Section 2.7 of the Technical Report.

No streams within the Antelope Creek Basin are listed on the US EPA Section 303(d) list, which categories impaired surface water bodies. The Upper Powder River Basin is listed on the Section 303(d) list for chloride and selenium from the South Fork of the Powder River to an undetermined distance downstream below Sussex, WY. The Upper Belle Fourche River Basin is listed on the Section 303(d) list for ammonia and total residual chlorine downstream of the Hulett Wastewater Treatment Plant (US EPA 2007).

According to the Wyoming Department of Environmental Quality (WDEQ), Antelope Creek is classified as a 3B surface water, meaning its designated use is for recreation, other aquatic life, wildlife, agriculture, industry, and scenic value. The North Fork of the Powder River is classified as a 2AB surface water, which means its designated use is for drinking water, game and non-game fisheries, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry, and scenic value. The Upper Belle Fourche River is classified as a 2ABWW surface water, and its associated designated uses are drinking water, game and non-game fisheries, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry, and scenic value (WY DEQ 2001).

### 2.2.3.2 Groundwater

Regional Groundwater Hydrology

The License Area is located at the southwestern edge of the Northern Great Plains aquifer system, which underlies most of the Dakotas and parts of Montana and Wyoming (USGS 1996). The major aquifers of the Northern Great Plains aquifer system are sandstones of Tertiary and Cretaceous age and carbonate rocks of Paleozoic age. These are overlain by unconsolidated deposits of Quaternary age, some of which are locally highly permeable and underlain by crystalline rocks that yield little water (USGS 1996).

Regional movement of water in the Northern Great Plains aquifer system comes from recharge areas at high altitudes, down the dip of the aquifers and then upward to discharge into shallower aquifers or to the land surface. The regional direction of flow in the deep, confined aquifers follows long flow paths and trends from southwest to northeast. Most of the recharge to the aquifer system is either from precipitation or snowmelt. Much of the discharge from the aquifer system is by upward leakage of water into shallower aquifers where the hydraulic head in the shallower aquifer is less than that of a deeper aquifer (USGS 1996).

The water-bearing units in the Northern Great Plains aquifer system can be divided into six major aquifer systems. From shallowest to deepest, these include:

- Quaternary Aquifers
- Middle Tertiary Aquifers
- Lower Tertiary Aquifers
- Upper Cretaceous Aquifers
- Lower Cretaceous Aquifers
- Paleozoic Aquifers

Table 2.2-7 shows these units along with the corresponding geologic formation, general transmissivity and water yields for the Northern Great Plains aquifer systems. Units younger than Lower Tertiary are typically not present within the vicinity of Moore Ranch and therefore are of no significance with respect to groundwater supply. Aquifer systems and geologic formations applicable to the Moore Ranch Project are discussed in greater detail in Section 2.7.

Water use estimates for Campbell County for different water use types are presented in Table 2.2-8.

**Table 2.2-7** Northern Great Plains Aquifer Systems and Formations General Characteristics

| Aquifer System | Formations | General Transmissivity (gpd/ft). | General Water Yields (gpm) |
|---|---|---|---|
| Quaternary Aquifers | Alluvium, Terrace, and Eolian Deposits | 15 to 64,000 | Up to 1,000 |
| Middle Tertiary Aquifers | Arikaree Formation | Up to 77,000 | Up to 1,000 |
| Lower Tertiary Aquifers | Wasatch and Fort Union Formations | 1 to 5,,000 | 1 to 60 |
| Upper Cretaceous Aquifers | Lance and Fox Hills Formations | 76 to 2,100 | Up to 350 gpm (Lance) and 700 gpm (Fox Hills) |
| Lower Cretaceous Aquifers | Dakota Sandstone Formation | 220-810 | Up to 150 |
| Paleozoic Aquifers | Madison Limestone Formation | 1,000 to 300,000 | Up to 1,000 |

(HKM et al. 2002).

**Table 2.2-8 Estimated Water Use in Campbell County, Wyoming**

| Water Use Type | Withdraws (MGD) |
|---|---|
| Public Supply | 1.88 |
| Domestic GW | 0.01 |
| Industrial GW | 0.25 |
| Industrial SW | 0.15 |
| Irrigated Acres, sprinkler | 0.00184 |
| Irrigated Acres, surface flood | 0.01096 |
| Irrigated Acres, total | 0.01280 |
| Irrigation GW | 1.26 |
| Irrigation SW | 40.85 |
| Irrigation, total | 42.11 |
| Mining GW | 56.67 |
| Mining SW | 13.29 |
| Mining, total | 69.96 |
| Thermoelectric, total | 0.41 |
| Total GW, fresh | 41.26 |
| Total GW, saline | 18.97 |
| Total GW | 60.22 |
| Total SW, fresh | 54.55 |
| Total SW, saline | 0 |
| Total SW | 54.55 |

Source: Hutson et al. 2000
Notes: GW = Groundwater
SW = Surface water
MGD = Million gallons per day

Study Area Groundwater Quantity

The License Area is situated in the southwestern part of the Powder River Basin. The surface unit in the area is Wasatch Formation which is underlain by Fort Union Formation. The Wasatch Formation is further divided into sand layers interbedded with coal and mudstone. The target production zone is referred to as the 70 Sand. The thickness of 70 Sand is normally in the range of 60 to 80 feet and the dip is generally less than one degree toward the northwest. Recharge to the 70 Sand occurs mainly in the outcrop area located southeast of the License Area. The first water bearing formation above the 70 Sand is the 72 Sand (overburden) and first water bearing strata below is represented by the 68 Sand (underburden). Deeper buried 40 and 50 Sands extend areally and are locally considered very significant aquifers (Conoco 1980).

According to the Wyoming State Engineers Office, there are 439 wells located within the 2-mile radius of the License Area (WSEO 2005). In general, groundwater supplies in the vicinity of the License Area include shallow alluvial sediments and sandstone layers within the Wasatch aquifer typically encountered from surface up to depth of 1,100 feet below ground surface (bgs) in this area (Conoco 1980). A summary of groundwater wells in the License Area and the 2-mile radius is presented in Addendum 2.2-A.

The static water level measurements from three domestic water wells within the 2-mile review area ranged from 40 to 85 feet bgs. Stock water well static level depths ranged from 4 to 320 feet bgs and water levels from 21 monitoring wells ranged between 70 and 208 feet bgs (WSEO 2005). Detailed Historic and recent water level information and aquifer properties for wells within the license boundary are presented in Section 2.7.

Study Area Groundwater Quality

EMC has conducted groundwater quality sampling at 16 monitoring wells and 4 stock water wells located within the License Area. These samples were analyzed for the water quality constituents listed in Table 2.2-9. The objective of this sampling was to characterize the water quality in the target formation and surrounding aquifers. Sampling was performed on a quarterly basis beginning with the first quarter of 2007. Additionally, historical water quality data was collected from private and monitoring wells by Conoco Inc. in 1979 and 1980.

Sample collection and preservation were performed using standard EPA methods. Prior to sampling, all field pH and conductivity meters were calibrated using known standards. Prior to sampling, each well was purged by pumping. Proper chain of custody documentation was completed and samples were transported to the lab for analysis. A summary of the results for the 2007 groundwater quality monitoring, as well as the historical Conoco data, is presented in Section 2.7.

**Table 2.2-9 Water Quality Indicators**

**Physical Indicators**

| | |
|---|---|
| Specific Conductance | Total Dissolved Solids |
| Temperature | pH |

**Common Constituents**

| | | | |
|---|---|---|---|
| Ammonia | Chloride | Silica | Bicarbonate |
| Magnesium | Sodium | Calcium | Nitrogen |
| Sulfate | Carbonate | Nitrite | Potassium |

**Trace and Minor Elements**

| | | | |
|---|---|---|---|
| Arsenic | Fluoride | Nickel | Boron |
| Iron | Selenium | Barium | Lead |
| Vanadium | Cadmium | Manganese | Zinc |
| Chromium | Mercury | Copper | Molybdenum |
| Aluminum | | | |

**Radionuclides**

| | | | |
|---|---|---|---|
| Radium-226 | Natural Uranium | Thorium-230 | Lead-210 |
| Polonium-210 | Radium-228 | Gross Alpha | Gross Beta |

Study Area Groundwater Use

According to the Wyoming State Engineers Office, there are 439 wells located within the 2-mile radius of the License Area boundary as of December, 2005. Most of the groundwater pumped from active wells surveyed within a 2-mile radius of the License Area boundary is used either for stock or CBM production.

Figure 2.2-3 shows the locations of all water wells in the License Area and the 2-mile radius review area. Within this area, there are three domestic water wells ranging from 180 to 440 feet in depth. Permitted yields for these wells vary between 15 and 20 gpm, and static water level ranges between 40 to 85 feet bgs. While these wells are permitted for domestic use, there are no current occupied residences within the License Area and 2-mile radius. Therefore, these wells are not being primarily utilized for human consumption. There are no irrigation wells located within the surveyed 2-mile radius of the License Area boundary. Stock water wells depths range between 2 and 1,200 feet bgs, with static level depth from 4 to 320 feet bgs and yields between 1 and 40 gpm. CBM wells are up to 1,481 feet deep. Water levels from 21 monitoring wells within the License Area boundary range between 70 and 208 feet bgs. Depth of these monitoring wells ranges between 165 to 300 feet bgs (WSEO 2005).

Additionally, there are four stock wells located within the License Area that are older and as a result not permitted through the SEO. There is also a windmill and a shallow well located in the License Area. However, it is not functional.

In summary, there are three water wells permitted for domestic use and no irrigation groundwater wells within the 2-mile radius review area. Based on population projections, future water use within the 2-mile radius review area would likely be a continuation of present use.

Operational Water Use

Based on a bleed of 0.5% to 1.5% which has been successfully applied at other ISR operations, the potential impact from consumptive use of groundwater is expected to be minimal. In this regard, the vast majority (e.g., on the order of 99%) of groundwater used in the mining process will be treated and re-injected (Figure 3.1-5). Potential impacts on groundwater quality due to consumptive use outside the permit area are expected to be negligible. Impacts from operational water consumption are described in detail in Section 7.2.

### 2.2.4 References

#### 2.2.4.1 Land Use References

DeLorme Maps. 2003. Wyoming Atlas and Gazetteer. Yarmouth, Maine.

National Agricultural Statistics Service (NASS). 2007. Campbell County Agriculture. [Web Page] Located at: http://www.nass.usda.gov/wy/internet/cntydata/campbell05.pdf. Accessed: June 5, 2007.

United States Department of Agriculture (USDA) National Agricultural Statistics Service. 2006. 2006 Livestock Inventory for Campbell County, Wyoming. [Web Page] Located at: http://www.nass.usda.gov/QuickStats/Create_County_Indv.jsp. Accessed: June 5, 2007.

United States Nuclear Regulatory Commission, NUREG-1569, *Standard Review Plan for In situ Leach Uranium Extraction License Applications*. 2003.

United States Nuclear Regulatory Commission (U.S. NRC). 2007. Locations of Fuel Cycle Facilities. [Web Page] http://www.nrc.gov/info-finder/materials/fuel-cycle/. Accessed on August 8, 2007.

Wyoming Department of Transportation (WYDOT). 2005. 2004 Vehicle Miles Traveled. [Web Page] Located at: http://www.dot.state.wy.us/Default.jsp?sCode=hompn. Accessed: June 18, 2007.

Wyoming Oil and Gas Conservation Commission. 2007. Production by Federal Lease, 2006 Total Annual Production. [Web Page] Located at: http://wogcc.state.wy.us/. Accessed: July 9, 2007.

#### 2.2.4.2 Water Use References

HKM Engineering Inc. (HKM), Lord Consulting, and Watts & Associates. 2002. Northeast Wyoming River Basins Plan. Executive Summary. 12 p.

Hutson, S. S., Barber, N. L., Kenny, J. F., Linsey, K. S., Lumia, D. S. and M. A. Maupin. 2000. USGS. Estimated Use of Water in the United States in 2000. [Web page] http://water.usgs.gov/watuse/. Accessed June 22, 2007.

Riggs, H. C. 1968. Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter A2, Frequency Curves. Book 4: Hydrologic Analysis and Interpretation. 15 p.

United States Environmental Protection Agency (US EPA) 2007. Total Maximum Daily Loads. List of Impaired Waters. Section 303(d) Fact Sheets. [Web pages] Antelope Basin: http://iaspub.epa.gov/tmdl/huc_rept.control?p_huc=10120101&p_huc_desc=ANTELOPE, Upper Powder River Basin: http://iaspub.epa.gov/tmdl/huc_rept.control?p_huc=10090202&p_huc_desc=UPPER%20POWDER, Upper Belle Fourche Basin: http://iaspub.epa.gov/tmdl/huc_rept.control?p_huc=10120201&p_huc_desc=UPPER%20BELLE%20FOURCHE. Accessed June 18, 2007.

United States Geological Survey (USGS). 1977. Digital Raster Graphics. 7.5 Minute Quadrangles: Pine Tree, Turnercrest, Ross Flat, Macken Draw, The Nose West. Projection: UTM zone 13. North American Datum 1927.

U.S. Nuclear Regulatory Commission, NUREG-1569, *Standard Review Plan for In situ Leach Uranium Extraction License Applications*. 2003.

USGS. 2007. National Water Information System (NWIS) for USGS stream gages in Wyoming: 06364700, 06313590, 06425720. [Web page] http://waterdata.usgs.gov/wy/nwis/sw. Accessed June 12, 2007.

Whitehead, R.L. 1996. GROUND WATER ATLAS of the UNITED STATES Montana, North Dakota, South Dakota, Wyoming. USGS HA 730-I.

Wyoming Department of Environmental Quality (WY DEQ). 2001. Wyoming Surface Water Classification List. Water Quality Division, Surface Water Standards. 21 June 2001. 484 p. [Web page] http://deq.state.wy.us/wqd/watershed/surfacestandards/Downloads/Standards/2-3648-doc.pdf. Accessed June 11, 2007.

World Information Service on Energy Uranium Project (Wise Uranium). 2007. Uranium Mine Ownership in Wyoming, USA. [Web Page] http://www.wise-uranium.org/uowy.html. Accessed on August 9, 2007.

# Addendum 2.2-A

Ground Water Rights within a 2-Mile Radius

Adde[illegible]2-A
Summary of Groundwater Wells

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P130611W | 43.56295000000 | -105.80300000000 | DEVON ENERGY PROD. CO., L.P. 2** WY | STATE ARCHIBALD 31S-13 | CBM | 25 | 984 | 600 |
| P139124W | 43.60304000000 | -105.83870000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 23S-3 | CBM | 25 | 1297 | 937 |
| P139125W | 43.59953000000 | -105.84370000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 23S-5 | CBM | 25 | 1351 | 890 |
| P139126W | 43.59573000000 | -105.83840000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 23S-11 | CBM | 25 | 1386 | 1007 |
| P139127W | 43.59222000000 | -105.84320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 23S-13 | CBM | 25 | 1378 | 1024 |
| P139128W | 43.60283000000 | -105.81790000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 24S-3 | CBM | | | |
| P139129W | 43.59908000000 | -105.82300000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 24S-5 | CBM | 25 | 1252 | 1193 |
| P139130W | 43.59556000000 | -105.81790000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 24S-11 | CBM | | | |
| P139131W | 43.59178000000 | -105.82300000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 24S-13 | CBM | 25 | 1289 | 1179 |
| P139132W | 43.58857000000 | -105.85820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-3 | CBM | | | |
| P139133W | 43.58482000000 | -105.86320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-5 | CBM | | | |
| P139134W | 43.58105000000 | -105.85820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-11 | CBM | | | |
| P139135W | 43.57733000000 | -105.86320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-13 | CBM | | | |
| P139273W | 43.58480000000 | -105.85320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 27S-7 | CBM | 25 | 1131 | 483 |
| P139274W | 43.57727000000 | -105.85310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 27S-15 | CBM | | | |
| P139462W | 43.55926000000 | -105.82800000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 2S-1 | CBM | | | |
| P139463W | 43.55924000000 | -105.83810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 2S-3 | CBM | | | |
| P139464W | 43.55555000000 | -105.84310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 2S-5 | CBM | | | |
| P139465W | 43.55557000000 | -105.83310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 2S-7 | CBM | | | |
| P139466W | 43.55192000000 | -105.82810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 2S-9 | CBM | | | |
| P139467W | 43.55190000000 | -105.83810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 2S-11 | CBM | | | |
| P139468W | 43.54823000000 | -105.84310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 2S-13 | CBM | | | |
| P139469W | 43.55920000000 | -105.85810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 3S-3 | CBM | | | |
| P139470W | 43.55553000000 | -105.86310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 3S-5 | CBM | | | |
| P139471W | 43.55189000000 | -105.84810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 3S-9 | CBM | | | |
| P139472W | 43.55187000000 | -105.85810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 3S-11 | CBM | | | |
| P139474W | 43.55920000000 | -105.86820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 4S-1 | CBM | | | |
| P139475W | 43.57367000000 | -105.86820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER CEEEK FEDERAL 33S-1 | CBM | | | |
| P139476W | 43.57006000000 | -105.87320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER CEEEK FEDERAL 33S-7 | CBM | | | |
| P139477W | 43.56644000000 | -105.86820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER CEEEK FEDERAL 33S-9 | CBM | | | |
| P139478W | 43.56285000000 | -105.87320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER CEEEK FEDERAL 33S-15 | CBM | | | |
| P139479W | 43.58856000000 | -105.86830000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 29S-1 | CBM | | | |
| P139480W | 43.58108000000 | -105.86820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 28S-9 | CBM | | | |
| P139481W | 43.57734000000 | -105.87320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 28S-15 | CBM | | | |
| P148712W | 43.52290000000 | -105.78770000000 | BILL BARRETT CORPORATION | PALM 43-18-4174 | CBM | 7 | 821 | 358 |
| P148713W | 43.51193000000 | -105.79270000000 | BILL BARRETT CORPORATION | PALM 32-19-4174 | CBM | 22 | 855 | 505 |
| P153683W | 43.55583000000 | -105.78270000000 | BILL BARRETT CORPORATION | DIAMOND T 12-5-4174 | CBM | 18 | 991 | 823 |
| P153684W | 43.55220000000 | -105.77770000000 | BILL BARRETT CORPORATION | DIAMOND T 23-5-4174 | CBM | 17 | 1037 | 684 |
| P153685W | 43.54855000000 | -105.77260000000 | BILL BARRETT CORPORATION | DIAMOND T 34-5-4174 | CBM | 16 | 1030 | 980 |
| P153686W | 43.55224000000 | -105.76760000000 | BILL BARRETT CORPORATION | DIAMOND T 43-5-4174 | CBM | 15 | 1062 | 1018 |
| P153687W | 43.55935000000 | -105.79790000000 | BILL BARRETT CORPORATION | DIAMOND T 21-6-4174 | CBM | 16 | 986 | 740 |
| P153688W | 43.55575000000 | -105.79280000000 | BILL BARRETT CORPORATION | DIAMOND T 32-6-4174 | CBM | 17 | 982 | 699 |
| P153689W | 43.55214000000 | -105.78780000000 | BILL BARRETT CORPORATION | DIAMOND T 43-6-4174 | CBM | 10 | 1012 | 762 |
| P153690W | 43.53372000000 | -105.80290000000 | BILL BARRETT CORPORATION | DIAMOND T 14-7-4174 | CBM | 20 | 958 | 6247 |
| P153691W | 43.53742000000 | -105.79790000000 | BILL BARRETT CORPORATION | DIAMOND T 23-7-4174 | CBM | 20 | 947 | 580 |
| P153692W | 43.53381000000 | -105.79270000000 | BILL BARRETT CORPORATION | DIAMOND T 34-7-4174 | CBM | 19 | 848 | 449 |
| P153693W | 43.53751000000 | -105.78770000000 | BILL BARRETT CORPORATION | DIAMOND T 43-7-4174 | CBM | 22 | 901 | 574 |
| P153694W | 43.52658000000 | -105.78260000000 | BILL BARRETT CORPORATION | NINE MILE 12-17-4174 | CBM | 22 | 809 | 587 |
| P153695W | 43.51926000000 | -105.78270000000 | BILL BARRETT CORPORATION | NINE MILE 14-17-4174 | CBM | | | |
| P153696W | 43.52638000000 | -105.80290000000 | BILL BARRETT CORPORATION | DIAMOND T 12-18-4174 | CBM | 13 | 721 | 486 |
| P153697W | 43.53010000000 | -105.79780000000 | BILL BARRETT CORPORATION | DIAMOND T 21-18-4174 | CBM | 15 | 881 | 503 |
| P153698W | 43.52279000000 | -105.79780000000 | BILL BARRETT CORPORATION | NINE MILE 23-18-4174 | CBM | 15 | 852 | 552 |
| P153699W | 43.51921000000 | -105.79270000000 | BILL BARRETT CORPORATION | NINE MILE 34-18-4174 | CBM | 22 | 791 | 460 |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P153700W | 43.51560000000 | -105.78770000000 | BILL BARRETT CORPORATION | NINE MILE 41-19-4174 | CBM | | | |
| P153927W | 43.55565000000 | -105.80300000000 | BILL BARRETT CORPORATION | DIAMOND T 12-6-4174 | CBM | 9 | 999 | 681 |
| P154591W | 43.52996000000 | -105.81800000000 | BILL BARRETT CORPORATION | MOORE WIRC 21-13-4175 | CBM | 19 | 887 | 578 |
| P154592W | 43.53725000000 | -105.82810000000 | BILL BARRETT CORPORATION | MOORE WIRC 43-11-4175 | CBM | 18 | 941 | 650 |
| P154593W | 43.54093000000 | -105.82300000000 | BILL BARRETT CORPORATION | MOORE WIRC 12-12-4175 | CBM | 18 | 994 | 688 |
| P154594W | 43.53359000000 | -105.82300000000 | BILL BARRETT CORPORATION | MOORE WIRC 14-12-4175 | CBM | 14 | 914 | 589 |
| P154595W | 43.52626000000 | -105.82300000000 | BILL BARRETT CORPORATION | MOORE WIRC 12-13-4175 | CBM | 18 | 955 | 664 |
| P154596W | 43.52631000000 | -105.81290000000 | BILL BARRETT CORPORATION | MOORE WIRC 32-13-4175 | CBM | 20 | 859 | 554 |
| P154747W | 43.55586000000 | -105.77770000000 | BILL BARRETT CORPORATION | DIAMOND T 22-5-4174 | CBM | 18 | 1015 | 679 |
| P155688W | 43.54824000000 | -105.83310000000 | BILL BARRETT CORPORATION | WALKER CREEK 34-2-4175 | CBM | 17 | 1011 | 711 |
| P155689W | 43.54826000000 | -105.82310000000 | BILL BARRETT CORPORATION | WALKER CREEK 14-1-4175 | CBM | 13 | 1031 | 706 |
| P155690W | 43.54458000000 | -105.82810000000 | BILL BARRETT CORPORATION | WALKER CREEK 41-11-4175 | CBM | 19 | 1021 | 745 |
| P155742W | 43.55209000000 | -105.79280000000 | BILL BARRETT CORPORATION | DIAMOND T 33-6-4174 | CBM | 15 | 961 | 709 |
| P155743W | 43.55580000000 | -105.78780000000 | BILL BARRETT CORPORATION | DIAMOND T 42-6-4174 | CBM | 14 | 1020 | 764 |
| P155744W | 43.52634000000 | -105.80790000000 | BILL BARRETT CORPORATION | DIAMOND T 42-13-4175 | CBM | 12 | 876 | 495 |
| P156307W | 43.55217000000 | -105.78270000000 | BILL BARRETT CORPORATION | DIAMOND T 13-5-4174 | CBM | 17 | 1019 | 705 |
| P156308W | 43.51560000000 | -105.78770000000 | BILL BARRETT CORPORATION | NINE MILE 41-19-4174 | CBM | 19 | 778 | 552 |
| P156309W | 43.51924000000 | -105.77770000000 | BILL BARRETT CORPORATION | NINE MILE 24-17-4174 | CBM | 21 | 727 | 445 |
| P156395W | 43.55596000000 | -105.75260000000 | BILL BARRETT CORPORATION | FEDERAL 32-4-4174 | CBM | 16 | 858 | 483 |
| P156399W | 43.55589000000 | -105.77270000000 | BILL BARRETT CORPORATION | FEDERAL 32-5-4174 | CBM | 15 | 1042 | 705 |
| P156400W | 43.55959000000 | -105.76770000000 | BILL BARRETT CORPORATION | FEDERAL 41-5-4174 | CBM | 20 | 955 | 622 |
| P156401W | 43.54834000000 | -105.80300000000 | BILL BARRETT CORPORATION | FEDERAL 14-6-4174 | CBM | 15 | 990 | 734 |
| P156402W | 43.55205000000 | -105.79790000000 | BILL BARRETT CORPORATION | FEDERAL 23-6-4174 | CBM | 19 | 967 | 846 |
| P156403W | 43.54474000000 | -105.79790000000 | BILL BARRETT CORPORATION | FEDERAL 21-7-4174 | CBM | | | |
| P156404W | 43.54482000000 | -105.78770000000 | BILL BARRETT CORPORATION | FEDERAL 41-7-4174 | CBM | | | |
| P156405W | 43.54120000000 | -105.78260000000 | BILL BARRETT CORPORATION | FEDERAL 12-8-4174 | CBM | 16 | 1000 | 706 |
| P156406W | 43.53389000000 | -105.78260000000 | BILL BARRETT CORPORATION | FEDERAL 14-8-4174 | CBM | 11 | 897 | 587 |
| P156407W | 43.54487000000 | -105.77770000000 | BILL BARRETT CORPORATION | FEDERAL 21-8-4174 | CBM | 10 | 1018 | 771 |
| P156408W | 43.53756000000 | -105.77760000000 | BILL BARRETT CORPORATION | FEDERAL 23-8-4174 | CBM | 9 | 952 | 598 |
| P156409W | 43.54123000000 | -105.77260000000 | BILL BARRETT CORPORATION | FEDERAL 32-8-4174 | CBM | 11 | 1011 | 668 |
| P156410W | 43.53390000000 | -105.77260000000 | BILL BARRETT CORPORATION | FEDERAL 34-8-4174 | CBM | 12 | 841 | 513 |
| P156411W | 43.54491000000 | -105.76760000000 | BILL BARRETT CORPORATION | FEDERAL 41-8-4174 | CBM | 11 | 1062 | 728 |
| P156412W | 43.53758000000 | -105.76760000000 | BILL BARRETT CORPORATION | FEDERAL 43-8-4174 | CBM | 10 | 963 | 595 |
| P156413W | 43.54126000000 | -105.76260000000 | BILL BARRETT CORPORATION | FEDERAL 12-9-4174 | CBM | 13 | 985 | 704 |
| P156414W | 43.53393000000 | -105.76260000000 | BILL BARRETT CORPORATION | FEDERAL 14-9-4174 | CBM | 14 | 909 | 579 |
| P156415W | 43.54494000000 | -105.75760000000 | BILL BARRETT CORPORATION | FEDERAL 21-9-4174 | CBM | 13 | 911 | 591 |
| P156431W | 43.53024000000 | -105.77760000000 | BILL BARRETT CORPORATION | FEDERAL 21-17-4174 | CBM | 15 | 840 | 525 |
| P156432W | 43.52657000000 | -105.77270000000 | BILL BARRETT CORPORATION | FEDERAL 32-17-4174 | CBM | 15 | 827 | 526 |
| P156433W | 43.53024000000 | -105.76760000000 | BILL BARRETT CORPORATION | FEDERAL 41-17-4174 | CBM | 14 | 863 | 531 |
| P156435W | 43.55559000000 | -105.82300000000 | BILL BARRETT CORPORATION | FEDERAL 12-1-4175 | CBM | 15 | 1028 | 783 |
| P156436W | 43.55927000000 | -105.81800000000 | BILL BARRETT CORPORATION | FEDERAL 21-1-4175 | CBM | 16 | 1063 | 866 |
| P156437W | 43.55194000000 | -105.81800000000 | BILL BARRETT CORPORATION | FEDERAL 23-1-4175 | CBM | 18 | 1044 | 764 |
| P156438W | 43.55561000000 | -105.81300000000 | BILL BARRETT CORPORATION | FEDERAL 32-1-4175 | CBM | 17 | 1052 | 695 |
| P156439W | 43.54829000000 | -105.81300000000 | BILL BARRETT CORPORATION | FEDERAL 34-1-4175 | CBM | 17 | 1052 | 730 |
| P156440W | 43.55928000000 | -105.80800000000 | BILL BARRETT CORPORATION | FEDERAL 41-1-4175 | CBM | 17 | 1013 | 821 |
| P156441W | 43.55197000000 | -105.80800000000 | BILL BARRETT CORPORATION | FEDERAL 43-1-4175 | CBM | 15 | 1074 | 762 |
| P156442W | 43.55555000000 | -105.84310000000 | BILL BARRETT CORPORATION | FEDERAL 12-2-4175 | CBM | 15 | 1122 | 810 |
| P156443W | 43.54823000000 | -105.84310000000 | BILL BARRETT CORPORATION | FEDERAL 14-2-4175 | CBM | 17 | 1034 | 834 |
| P156444W | 43.55924000000 | -105.83810000000 | BILL BARRETT CORPORATION | FEDERAL 21-2-4175 | CBM | 14 | 1139 | 836 |
| P156445W | 43.55190000000 | -105.83810000000 | BILL BARRETT CORPORATION | FEDERAL 23-2-4175 | CBM | 17 | 1122 | 800 |
| P156446W | 43.55557000000 | -105.83310000000 | BILL BARRETT CORPORATION | FEDERAL 32-2-4175 | CBM | 17 | 1040 | 757 |
| P156447W | 43.55926000000 | -105.82800000000 | BILL BARRETT CORPORATION | FEDERAL 41-2-4175 | CBM | 6 | 1102 | 887 |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P156448W | 43.54461000000 | -105.81800000000 | BILL BARRETT CORPORATION | FEDERAL 21-12-4175 | CBM | 15 | 1018 | 676 |
| P156449W | 43.53729000000 | -105.81800000000 | BILL BARRETT CORPORATION | FEDERAL 23-12-4175 | CBM | 18 | 977 | 631 |
| P156450W | 43.54097000000 | -105.81300000000 | BILL BARRETT CORPORATION | FEDERAL 32-12-4175 | CBM | 20 | 1030 | 715 |
| P156451W | 43.53365000000 | -105.81300000000 | BILL BARRETT CORPORATION | FEDERAL 34-12-4175 | CBM | 19 | 963 | 679 |
| P156452W | 43.54465000000 | -105.80800000000 | BILL BARRETT CORPORATION | FEDERAL 41-12-4175 | CBM | 17 | 1032 | 811 |
| P156453W | 43.53734000000 | -105.80790000000 | BILL BARRETT CORPORATION | FEDERAL 43-12-4175 | CBM | 10 | 995 | 710 |
| P156454W | 43.51893000000 | -105.82310000000 | BILL BARRETT CORPORATION | FEDERAL 14-13-4175 | CBM | 23 | 912 | 624 |
| P156455W | 43.52262000000 | -105.81800000000 | BILL BARRETT CORPORATION | FEDERAL 23-13-4175 | CBM | 19 | 931 | 642 |
| P156456W | 43.51903000000 | -105.81290000000 | BILL BARRETT CORPORATION | FEDERAL 34-13-4175 | CBM | 13 | 903 | 569 |
| P156457W | 43.52269000000 | -105.80790000000 | BILL BARRETT CORPORATION | FEDERAL 43-13-4175 | CBM | 7 | 883 | 656 |
| P156458W | 43.51167000000 | -105.82310000000 | BILL BARRETT CORPORATION | FEDERAL 12-24-4175 | CBM | 17 | 953 | 521 |
| P156459W | 43.51534000000 | -105.81800000000 | BILL BARRETT CORPORATION | FEDERAL 21-24-4175 | CBM | 20 | 903 | 542 |
| P156460W | 43.50809000000 | -105.81800000000 | BILL BARRETT CORPORATION | FEDERAL 23-24-4175 | CBM | 4 | 869 | 446 |
| P156461W | 43.56312000000 | -105.78280000000 | BILL BARRETT CORPORATION | FEDERAL 14-32-4274 | CBM | 14 | 1071 | 780 |
| P156462W | 43.56679000000 | -105.77770000000 | BILL BARRETT CORPORATION | FEDERAL 23-32-4274 | CBM | 15 | 1027 | 726 |
| P156463W | 43.56320000000 | -105.77270000000 | BILL BARRETT CORPORATION | FEDERAL 34-32-4274 | CBM | 2 | 1026 | 728 |
| P156577W | 43.54825000000 | -105.82810000000 | BILL BARRETT CORPORATION | WALKER CREEK 44-2-4175 | CBM | 18 | 1037 | 737 |
| P156615W | 43.57415000000 | -105.75750000000 | BILL BARRETT CORPORATION | NINEMILE 21-33-4274 | CBM | | | |
| P156616W | 43.57053000000 | -105.75260000000 | BILL BARRETT CORPORATION | NINEMILE 32-33-4274 | CBM | | | |
| P158295W | 43.58107000000 | -105.87830000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 28S-11 | CBM | | | |
| P158296W | 43.60694000000 | -105.87400000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (T-CHAIR) 16S-15 | CBM | | | |
| P158297W | 43.60688000000 | -105.88400000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (T-CHAIR) 16S-13 | CBM | | | |
| P158298W | 43.61420000000 | -105.88400000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (T-CHAIR) 16S-5 | CBM | | | |
| P158299W | 43.61790000000 | -105.87910000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (T-CHAIR) 16S-3 | CBM | | | |
| P158300W | 43.56293000000 | -105.89330000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 32S-15 | CBM | | | |
| P158301W | 43.56651000000 | -105.88820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 32S-9 | CBM | | | |
| P158302W | 43.57015000000 | -105.89330000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 32S-7 | CBM | | | |
| P158303W | 43.57370000000 | -105.88820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 32S-1 | CBM | | | |
| P158304W | 43.57733000000 | -105.88320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 28S-13 | CBM | | | |
| P158667W | 43.61428000000 | -105.87410000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (T CHAIR) 16S-7 | CBM | | | |
| P158668W | 43.61797000000 | -105.86920000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (T CHAIR) 16S-1 | CBM | | | |
| P158669W | 43.57734000000 | -105.87320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 28S-15 | CBM | 25 | 1165 | 705 |
| P158670W | 43.58108000000 | -105.86820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 28S-9 | CBM | | | |
| P158671W | 43.57733000000 | -105.86320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-13 | CBM | | | |
| P158672W | 43.58105000000 | -105.85820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-11 | CBM | 25 | 1358 | 910 |
| P158673W | 43.58482000000 | -105.86320000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-5 | CBM | | | |
| P158674W | 43.58857000000 | -105.85820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 27S-3 | CBM | 25 | 1365 | 629 |
| P165993W | 43.61061000000 | -105.87410000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (T CHAIR) 16S-10 | CBM | | | |
| P166070W | 43.58828000000 | -105.81790000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 25S-3 | CBM | | | |
| 37/6/408W | 43.59952000000 | -105.77260000000 | YATES PETROLEUM CORP. | STEVE CS #02 | CBM,MIS | | | |
| P163654W | 43.56329000000 | -105.75260000000 | YATES PETROLEUM CORP. | BIGHORN CS FEDERAL #13 | CBM,MIS | | | |
| P167696W | 43.56671000000 | -105.78780000000 | YATES PETROLEUM CORP. | SIOUX CS FEDERAL #01 | CBM,MIS,RES | | | |
| P158877W | 43.57769000000 | -105.77270000000 | YATES PETROLEUM CORP. | BIGHORN CS FEDERAL #5 | CBM,RES | 200 | 974 | 669 |
| P158878W | 43.59947000000 | -105.78280000000 | YATES PETROLEUM CORP. | CUSTER CS FEDERAL #2 | CBM,RES | | | |
| P158879W | 43.59589000000 | -105.76750000000 | YATES PETROLEUM CORP. | CUSTER CS FEDERAL #3 | CBM,RES | 200 | 1031 | 697 |
| P158880W | 43.59219000000 | -105.78280000000 | YATES PETROLEUM CORP. | CUSTER CS FEDERAL #5 | CBM,RES | | | |
| P158881W | 43.58860000000 | -105.76750000000 | YATES PETROLEUM CORP. | CUSTER CS FEDERAL #8 | CBM,RES | 200 | 948 | 608 |
| P158882W | 43.58489000000 | -105.78290000000 | YATES PETROLEUM CORP. | CUSTER CS FEDERAL #10 | CBM,RES | | | |
| P158883W | 43.57776000000 | -105.76250000000 | YATES PETROLEUM CORP. | BIGHORN CS FEDERAL #1 | CBM,RES | | | |
| P160346W | 43.60673000000 | -105.79280000000 | YATES PETROLEUM CORPORATION | PRATHER CS #4 | CBM,RES | 200 | 1179 | 801 |
| P160347W | 43.56686000000 | -105.76770000000 | YATES PETROLEUM CORPORATION | BIGHORN CS FEDERAL #9 | CBM,RES | | | |
| P160348W | 43.60314000000 | -105.77770000000 | YATES PETROLEUM CORPORATION | CUSTER CS FEDERAL #1 | CBM,RES | | | |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P161978W | 43.58864000000 | -105.75750000000 | YATES PETROLEUM CORP. | CUSTER CS FEDERAL #13 | CBM,RES | 200 | 956 | 633 |
| P162026W | 43.56326000000 | -105.76270000000 | YATES PETROLEUM CORP. | BIGHORN CS FEDERAL #12 | CBM,RES | | | |
| P9309W | 43.51924000000 | -105.77770000000 | JOHN W. MOORE | 9 MILE 1 | DOM | 20 | 273 | 85 |
| P12240P | 43.51924000000 | -105.77770000000 | JOHN W. MOORE | 9 MILE #2 | DOM,STO | 20 | 180 | 40 |
| P12299W | 43.56646000000 | -105.87320000000 | RIO ALGOM MINING CORP. | UM 1575 2 33 42 75 | IND,DOM | 15 | 440 | 60 |
| P60162W | 43.57353000000 | -105.83810000000 | POWER RESOURCES INC | CONOCO 1821 | IND,MIS | 40 | 1200 | 342 |
| P60163W | 43.57353000000 | -105.83810000000 | POWER RESOURCES INC | CONOCO 1822 | IND,MIS | 45 | 740 | 249 |
| P78584W | 43.53751000000 | -105.78770000000 | W. A. MONCRIEF, JR. | LUCKY PINE #7 1 | MIS | 50 | 960 | 200 |
| P161053W | 43.53751000000 | -105.78770000000 | Diamond T LLC | LUCKY PINE #7-1 | MIS | | | |
| P39648W | 43.56912000000 | -105.85200000000 | POWER RESOURCES INC | MOORE RANCH PROJECT D (42 75) 43 P | MON | 0 | 240 | 182 |
| P39649W | 43.56998000000 | -105.83810000000 | POWER RESOURCES INC | MOORE RANCH PROJECT D (42 75) 34 P | MON | 0 | 240 | 160 |
| P39650W | 43.56998000000 | -105.84310000000 | POWER RESOURCES INC | MOORE RACNCH PROJEACT D (42 75) 35 O | MON | 0 | 263 | 208 |
| P39651W | 43.57353000000 | -105.83810000000 | POWER RESOURCES INC | MOORE RANCH PROJECT D (42 75) 35 OB2 | MON | 0 | 275 | 144 |
| P39652W | 43.56996000000 | -105.82800000000 | POWER RESOURCES INC | MOORE RANCH PROJECT D (42 75) 35 OB3 | MON | 0 | 227 | 189 |
| P39653W | 43.57004000000 | -105.86320000000 | POWER RESOURCES INC | MOORE RANCH PROJECT D (42 75) 34 OB4 | MON | 0 | 260 | 164 |
| P39654W | 43.57445000000 | -105.85120000000 | POWER RESOURCES INC | MOORE RANCH PROJECT D (42 75) 34 OB5 | MON | 0 | 330 | 163 |
| P39655W | 43.55925000000 | -105.83300000000 | KERR-MCGEE NUCLEAR CORPORATION | MOORE RANCH PROJECT D(41-75)2-0B6 | MON | 0 | 165 | 99 |
| P39656W | 43.55921000000 | -105.85310000000 | KERR-MCGEE NUCLEAR CORPORATION | MOORE RANCH PROJECT D(41-75)3-OB7 | MON | 0 | 175 | 70 |
| P75097W | 43.56912000000 | -105.85200000000 | POWER RESOURCES INC | MOORE RANCH #886 | MON | 0 | 240 | 186 |
| P75098W | 43.56912000000 | -105.85200000000 | POWER RESOURCES INC | MOORE RANCH #887 | MON | 0 | 320 | 177.2 |
| P75099W | 43.56912000000 | -105.85200000000 | POWER RESOURCES INC | MOORE RANCH #888 | MON | 0 | 250 | 177.3 |
| P75100W | 43.56912000000 | -105.85200000000 | POWER RESOURCES INC | MOORE RANCH #893 | MON | 0 | 240 | 173.19 |
| P75101W | 43.56997000000 | -105.83300000000 | POWER RESOURCES INC | MOORE RANCH #1805 | MON | 0 | 240 | 154.1 |
| P75102W | 43.56997000000 | -105.83300000000 | POWER RESOURCES INC | MOORE RANCH #1806 | MON | 0 | 220 | 146 |
| P75103W | 43.56997000000 | -105.83300000000 | POWER RESOURCES INC | MOORE RANCH #1807 | MON | 0 | 290 | 160.5 |
| P75104W | 43.56287000000 | -105.84310000000 | POWER RESOURCES INC | MOORE RANCH #1814 | MON | 0 | 207 | 157.1 |
| P75105W | 43.56287000000 | -105.84310000000 | POWER RESOURCES INC | MOORE RANCH #1815 | MON | 0 | 208 | 159.6 |
| P75106W | 43.56287000000 | -105.84310000000 | POWER RESOURCES INC | MOORE RANCH #1816 | MON | 0 | 207 | 155.1 |
| P75107W | 43.56642000000 | -105.84310000000 | POWER RESOURCES INC | MOORE RANCH #1817 | MON | 0 | 233 | 162.9 |
| P75108W | 43.56287000000 | -105.84310000000 | POWER RESOURCES INC | MOORE RANCH #1823 | MON | 0 | 240 | 113.1 |
| P14660P | 43.58108000000 | -105.86820000000 | TAYLOR RANCH CO. | TAYLOR #29-1 | STO | 3 | 355 | 150 |
| P14670P | 43.55197000000 | -105.89320000000 | TAYLOR RANCH CO. | TAYLOR #41 1 | STO | 5 | 22 | 5 |
| P14683P | 43.58863000000 | -105.80280000000 | TAYLOR RANCH CO. | TAYLOR #57-1 | STO | 3 | 275 | 175 |
| P17305P | 43.54474000000 | -105.79790000000 | PINE TREE RANCH CO. | PINE TREE #6 | STO | 20 | 50 | 18 |
| P17306P | 43.58124000000 | -105.78290000000 | PINE TREE RANCH CO. | PINE TREE #7 | STO | 40 | 150 | 40 |
| P22296P | 43.51506000000 | -105.86310000000 | OGALALLA ALDN & CATTLE LIMITED PARTN | McNAUGHTIN PASTURE #1 | STO | 3 | 125 | 50 |
| P12244P | 43.57777000000 | -105.75750000000 | JOHN W. & VELMA R. MOORE | FARM #1 | STO | 20 | 200 | 100 |
| P14675P | 43.62855000000 | -105.80740000000 | TAYLOR RANCH CO. | TAYLOR #46-55-1 | STO | 4 | 275 | 195 |
| P14677P | 43.62129000000 | -105.79280000000 | TAYLOR RANCH CO. | TAYLOR #52-1 | STO | 4 | 275 | 180 |
| P14681P | 43.58851000000 | -105.84310000000 | TAYLOR RANCH CO. | TAYLOR #55-1 | STO | 3 | 158 | 80 |
| P14682P | 43.58465000000 | -105.83810000000 | TAYLOR RANCH CO. | TAYLOR #56-1 | STO | 3 | 158 | 80 |
| P14684P | 43.60671000000 | -105.80270000000 | TAYLOR RANCH CO. | TAYLOR #57-58-2 | STO | 4 | 350 | 235 |
| P35330W | 43.60640000000 | -105.82820000000 | TAYLOR RANCH COMPANY LIMITED | TAYLOR BLISS #1 | STO | 25 | 500 | 100 |
| P35746W | 43.59963000000 | -105.86380000000 | BROWN LAND COMPANY | WOODS #1 | STO | 15 | 660 | 320 |
| P37879W | 43.58128000000 | -105.77780000000 | PINE TREE RANCH CO.**CHARLES H. ARCH | PINE TREE #5 1 | STO | 2 | 8 | 4 |
| P50880W | 43.59960000000 | -105.87380000000 | T-CHAIR LIVESTOCK CO. | T-CHAIR LIVESTOCK COMPANY #21-1 | STO | 25 | 800 | 130 |
| P6972W | 43.56329000000 | -105.75260000000 | PINE TREE RANCH CO. | PINE TREE #8 | STO | 25 | 210 | 95 |
| P6973W | 43.55583000000 | -105.78270000000 | PINE TREE RANCH CO. | PINE TREE #9 | STO | 5 | 170 | 60 |
| P63571W | 43.60329000000 | -105.85900000000 | T-CHAIR LIVESTOCK CO. | CCI #8 UPPER | STO | 10 | 421 | 266 |
| P63572W | 43.60329000000 | -105.85900000000 | T-CHAIR LIVESTOCK CO. | CCI #8 MIDDLE | STO | 10 | 534 | 259 |
| P63573W | 43.60329000000 | -105.85900000000 | T-CHAIR LIVESTOCK CO. | CCI #8 LOWER | STO | 10 | 722 | 270 |
| P78123W | 43.51893000000 | -105.82310000000 | INC. W. I. MOORE RANCH CO. | MONA RAE #1 | STO | 20 | 200 | 100 |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P78124W | 43.51877000000 | -105.85810000000 | INC. W. I. MOORE RANCH CO. | V B #1 | STO | 5 | 100 | 75 |
| P120979W | 43.51550000000 | -105.80280000000 | W.I. MOORE RANCH COMPANY | Section 19-41-74 Well | STO | 8 | 160 | 35 |
| P120980W | 43.50819000000 | -105.80780000000 | W.I. MOORE RANCH COMPANY | F C #1 Spring | STO | 6 | 6 | 0 |
| P120981W | 43.50451000000 | -105.81290000000 | W.I. MOORE RANCH COMPANY | F C #2 Spring | STO | 6 | 4 | 0 |
| P120982W | 43.50451000000 | -105.81290000000 | W.I. MOORE RANCH COMPANY | F C #3 Spring | STO | 1 | 2 | 0 |
| P120983W | 43.50440000000 | -105.82810000000 | W.I. MOORE RANCH COMPANY | F C #4 Spring | STO | 3 | 3 | 0 |
| P120985W | 43.52626000000 | -105.84320000000 | W.I. MOORE RANCH COMPANY | Frankie #1 Well | STO | 7 | 150 | 30 |
| P81864W | 43.61055000000 | -105.91400000000 | T-CHAIR LAND COMPANY | KILL EM DEAD SMITH WELL #1 | STO | 25 | 1200 | 165 |
| P113642W | 43.56656000000 | -105.80800000000 | WYO BOARD OF LAND COMMISSIONERS** YA | PINE TREE DRAW CS STATE #1 | STO,CBM | 100 | 1075 | 773 |
| P114067W | 43.56998000000 | -105.84310000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER CREEK 35S-5 | STO,CBM | 25 | 1108 | 380 |
| P114068W | 43.56998000000 | -105.83810000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER CREEK 35S-6 | STO,CBM | 25 | 1146 | 390 |
| P114069W | 43.56642000000 | -105.83810000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER CREEK 35S-11 | STO,CBM | 25 | 1131 | 395 |
| P114070W | 43.56642000000 | -105.84310000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER CREEK 35S-12 | STO,CBM | 25 | 1044 | 392 |
| P114071W | 43.57364000000 | -105.81800000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 35S-3 | STO,CBM | 25 | 1079 | 400 |
| P114072W | 43.57354000000 | -105.82300000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 36S-4 | STO,CBM | 25 | 1140 | 400 |
| P114073W | 43.56999000000 | -105.82300000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 36S-5 | STO,CBM | 25 | 1148 | 380 |
| P114074W | 43.57006000000 | -105.81800000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 36S-6 | STO,CBM | 25 | 1108 | 390 |
| P114075W | 43.57749000000 | -105.80790000000 | DEVON ENERGY CORP.** IBERLIN RANCH P | IBERLIN 25S-16 | STO,CBM | 25 | 1081 | 771 |
| P114076W | 43.57711000000 | -105.82810000000 | DEVON ENERGY CORP.** IBERLIN RANCH P | IBERLIN 26S-16 | STO,CBM | 25 | 1171 | 390 |
| P114077W | 43.57356000000 | -105.84810000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER CREEK 34S-1 | STO,CBM | 25 | 1245 | 696 |
| P114078W | 43.56288000000 | -105.83300000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 35S-15 | STO,CBM | 25 | 1151 | 750 |
| P114079W | 43.57019000000 | -105.80790000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 36S-8 | STO,CBM | 25 | 1074 | 390 |
| P114080W | 43.56290000000 | -105.81800000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 36S-14 | STO,CBM | 25 | 1032 | 390 |
| P114081W | 43.58842000000 | -105.81290000000 | DEVON ENERGY CORP.** IBERLIN RANCH P | IBERLIN 25S-2 | STO,CBM | 25 | 1174 | 390 |
| P114082W | 43.58488000000 | -105.80780000000 | DEVON ENERGY CORP.** IBERLIN RANCH P | IBERLIN 25S-8 | STO,CBM | 25 | 1129 | 188 |
| P114083W | 43.58106000000 | -105.81290000000 | DEVON ENERGY CORP.** IBERLIN RANCH P | IBERLIN 25S-10 | STO,CBM | 25 | 1134 | 390 |
| P114084W | 43.57354000000 | -105.84310000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER CREEK 35S-4 | STO,CBM | 25 | 1180 | 400 |
| P114085W | 43.56287000000 | -105.84310000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER CREEK 35S-13 | STO,CBM | 25 | 1107 | 356 |
| P114086W | 43.57373000000 | -105.81300000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 36S-2 | STO,CBM | 25 | 1052 | 390 |
| P114087W | 43.56644000000 | -105.82300000000 | WYO BOARD OF LAND COMMISSIONERS** DE | WALKER CREEK ST 36S-12X | STO,CBM | 25 | 1148 | 1037 |
| P114089W | 43.55554000000 | -105.85310000000 | DEVON ENERGY CORP.** WALKER CREEK LI | WALKER FED 3S-7 | STO,CBM | 0 | 0 | 0 |
| P114102W | 43.56912000000 | -105.85200000000 | DEVON ENERGY CORP.** IBERLIN RANCH P | IBERLIN FED 34S-7 | STO,CBM | 0 | 0 | 0 |
| P114372W | 43.58102000000 | -105.84810000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 27S-9 | STO,CBM | 0 | 0 | 0 |
| P114374W | 43.58828000000 | -105.81790000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 25S-3 | STO,CBM | 0 | 0 | 0 |
| P114375W | 43.58447000000 | -105.82300000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 25S-5 | STO,CBM | 0 | 0 | 0 |
| P114376W | 43.58093000000 | -105.81800000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 25S-11 | STO,CBM | 0 | 0 | 0 |
| P114377W | 43.57715000000 | -105.82300000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 25S-13 | STO,CBM | 0 | 0 | 0 |
| P114378W | 43.58838000000 | -105.83810000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 26S-3 | STO,CBM | 0 | 0 | 0 |
| P114379W | 43.58097000000 | -105.84310000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 26S-5 | STO,CBM | 0 | 0 | 0 |
| P114380W | 43.58091000000 | -105.83810000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 26S-11 | STO,CBM | 0 | 0 | 0 |
| P114381W | 43.57721000000 | -105.84310000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 26S-13 | STO,CBM | 0 | 0 | 0 |
| P114382W | 43.58858000000 | -105.84810000000 | 1) DEVON ENERGY CORP 2) MR. MARK IBE | IBERLIN FED 27S-1 | STO,CBM | 0 | 0 | 0 |
| P114387W | 43.56997000000 | -105.83300000000 | 1) DEVON ENERGY CORP 2) WALKER CREEK | WALKER CREEK FED 35S-7 | STO,CBM | 0 | 0 | 0 |
| P114391W | 43.57350000000 | -105.82800000000 | 1) DEVON ENERGY CORP 2) WALKER CREEK | WALKER CREEK FED 35S-1 | STO,CBM | 0 | 0 | 0 |
| P114397W | 43.57026000000 | -105.93910000000 | 1) DEVON ENERGY CORP 2) STATE BOARD | IBERLIN RANCH STATE 36S-6 | STO,CBM | 25 | 1430 | 572 |
| P114398W | 43.56663000000 | -105.93400000000 | 1) DEVON ENERGY CORP 2) STATE BOARD | IBERLIN RANCH STATE 36S-10 | STO,CBM | 25 | 1384 | 828 |
| P114399W | 43.57030000000 | -105.93400000000 | 1) DEVON ENERGY CORP 2) STATE BOARD | IBERLIN RANCH STATE 36S-7 | STO,CBM | 25 | 1399 | 854 |
| P114400W | 43.56660000000 | -105.93900000000 | 1) DEVON ENERGY CORP 2) STATE BOARD | IBERLING RANCH STATE 36S-11 | STO,CBM | 25 | 1385 | 838 |
| P115374W | 43.57397000000 | -105.92910000000 | DEVON ENERGY CORP.** WY STATE BOARD | 1 RANCH STATE 36S-1 | STO,CBM | 25 | 1481 | 699 |
| P115377W | 43.56297000000 | -105.92900000000 | DEVON ENERGY CORP.** WY STATE BOARD | 1 RANCH STATE 36S-16 | STO,CBM | 25 | 1433 | 1284 |
| 38/1/80W | 43.53728000000 | -105.91850000000 | BILL BARRETT CORPORATION | FEDERAL 23-7-4175 | STO,CBM | | | |
| 38/1/81W | 43.52250000000 | -105.88810000000 | BILL BARRETT CORPORATION | FEDERAL 43-17-4175 | STO,CBM | | | |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| 38/1/82W | 43.50781000000 | -105.86830000000 | BILL BARRETT CORPORATION | FEDERAL 43-21-4175 | STO,CBM | | | |
| 38/10/79W | 43.53364000000 | -105.92370000000 | BILL BARRETT CORPORATION | FEDERAL 14-7-4175 | STO,CBM | | | |
| 38/10/80W | 43.52987000000 | -105.88810000000 | BILL BARRETT CORPORATION | FEDERAL 41-17-4175 | STO,CBM | | | |
| 38/10/81W | 43.51504000000 | -105.86810000000 | BILL BARRETT CORPORATION | FEDERAL 41-21-4175 | STO,CBM | | | |
| 38/2/80W | 43.53357000000 | -105.90320000000 | BILL BARRETT CORPORATION | FEDERAL 14-8-4175 | STO,CBM | | | |
| 38/2/82W | 43.51144000000 | -105.86320000000 | BILL BARRETT CORPORATION | FEDERAL 12-22-4175 | STO,CBM | | | |
| 38/2/83W | 43.50084000000 | -105.81790000000 | BILL BARRETT CORPORATION | FEDERAL 21-25-4175 | STO,CBM | | | |
| 38/3/80W | 43.54461000000 | -105.89820000000 | BILL BARRETT CORPORATION | FEDERAL 21-8-4175 | STO,CBM | | | |
| 38/3/82W | 43.50422000000 | -105.86330000000 | BILL BARRETT CORPORATION | FEDERAL 14-22-4175 | STO,CBM | | | |
| 38/3/84W | 43.50074000000 | -105.84830000000 | BILL BARRETT CORPORATION | FEDERAL 41-27-4175 | STO,CBM | | | |
| 38/4/80W | 43.53725000000 | -105.89820000000 | BILL BARRETT CORPORATION | FEDERAL 23-8-4175 | STO,CBM | | | |
| 38/4/81W | 43.52995000000 | -105.91850000000 | BILL BARRETT CORPORATION | FEDERAL 21-18-4175 | STO,CBM | | | |
| 38/4/82W | 43.51512000000 | -105.85810000000 | BILL BARRETT CORPORATION | FEDERAL 21-22-4175 | STO,CBM | | | |
| 38/4/83W | 43.50819000000 | -105.80780000000 | BILL BARRETT CORPORATION | FEDERAL 43-24-4175 | STO,CBM | | | |
| 38/5/79W | 43.55563000000 | -105.92370000000 | BILL BARRETT CORPORATION | FEDERAL 12-6-4175 | STO,CBM | | | |
| 38/5/80W | 43.53356000000 | -105.89310000000 | BILL BARRETT CORPORATION | FEDERAL 34-8-4175 | STO,CBM | | | |
| 38/5/81W | 43.52261000000 | -105.91860000000 | BILL BARRETT CORPORATION | FEDERAL 23-18-4175 | STO,CBM | | | |
| 38/5/82W | 43.50789000000 | -105.85820000000 | BILL BARRETT CORPORATION | FEDERAL 23-22-4175 | STO,CBM | | | |
| 38/5/83W | 43.50451000000 | -105.81290000000 | BILL BARRETT CORPORATION | FEDERAL 34-24-4175 | STO,CBM | | | |
| 38/6/79W | 43.55929000000 | -105.91850000000 | BILL BARRETT CORPORATION | FEDERAL 21-6-4175 | STO,CBM | | | |
| 38/6/80W | 43.52988000000 | -105.89820000000 | BILL BARRETT CORPORATION | FEDERAL 21-17-4175 | STO,CBM | | | |
| 38/6/81W | 43.51891000000 | -105.91350000000 | BILL BARRETT CORPORATION | FEDERAL 34-18-4175 | STO,CBM | | | |
| 38/6/82W | 43.51157000000 | -105.85320000000 | BILL BARRETT CORPORATION | FEDERAL 32-22-4175 | STO,CBM | | | |
| 38/7/79W | 43.55927000000 | -105.90840000000 | BILL BARRETT CORPORATION | FEDERAL 41-6-4175 | STO,CBM | | | |
| 38/7/80W | 43.52252000000 | -105.89830000000 | BILL BARRETT CORPORATION | FEDERAL 23-17-4175 | STO,CBM | | | |
| 38/7/81W | 43.51153000000 | -105.89340000000 | BILL BARRETT CORPORATION | FEDERAL 32-20-4175 | STO,CBM | | | |
| 38/7/82W | 43.50432000000 | -105.85330000000 | BILL BARRETT CORPORATION | FEDERAL 34-22-4175 | STO,CBM | | | |
| 38/8/79W | 43.55195000000 | -105.90830000000 | BILL BARRETT CORPORATION | FEDERAL 43-6-4175 | STO,CBM | | | |
| 38/8/80W | 43.52619000000 | -105.89320000000 | BILL BARRETT CORPORATION | FEDERAL 32-17-4175 | STO,CBM | | | |
| 38/8/81W | 43.51145000000 | -105.87320000000 | BILL BARRETT CORPORATION | FEDERAL 32-21-4175 | STO,CBM | | | |
| 38/8/82W | 43.51526000000 | -105.84820000000 | BILL BARRETT CORPORATION | FEDERAL 41-22-4175 | STO,CBM | | | |
| 38/9/79W | 43.54097000000 | -105.92370000000 | BILL BARRETT CORPORATION | FEDERAL 12-7-4175 | STO,CBM | | | |
| 38/9/80W | 43.51883000000 | -105.89320000000 | BILL BARRETT CORPORATION | FEDERAL 34-17-4175 | STO,CBM | | | |
| 38/9/81W | 43.50422000000 | -105.87340000000 | BILL BARRETT CORPORATION | FEDERAL 34-21-4175 | STO,CBM | | | |
| 38/9/82W | 43.50800000000 | -105.84820000000 | BILL BARRETT CORPORATION | FEDERAL 43-22-4175 | STO,CBM | | | |
| 38/9/83W | 43.50065000000 | -105.85830000000 | BILL BARRETT CORPORATION | FEDERAL 21-27-4175 | STO,CBM | | | |
| P135571W | 43.57396000000 | -105.78790000000 | YATES PETROLEUM CORPORATION | McPARTLIN CS FEE #1 | STO,CBM | | | |
| P135572W | 43.57391000000 | -105.79800000000 | YATES PETROLEUM CORPORATION | McPARTLIN CS FEE #2 | STO,CBM | | | |
| P135573W | 43.57024000000 | -105.80300000000 | YATES PETROLEUM CORPORATION | McPARTLIN CS FEE #3 | STO,CBM | | | |
| P135574W | 43.57030000000 | -105.79290000000 | YATES PETROLEUM CORPORATION | MCPARTLIN CS FEE #4 | STO,CBM | | | |
| P135873W | 43.51872000000 | -105.87310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-15 | STO,CBM | 25 | 1162 | 518 |
| P135874W | 43.52239000000 | -105.86810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-9 | STO,CBM | 25 | 1122 | 486 |
| P135938W | 43.57049000000 | -105.76760000000 | YATES PETROLEUM CORP. | OLSWICK CS FEE #5 | STO,CBM | | | |
| P135939W | 43.57403000000 | -105.77770000000 | YATES PETROLEUM CORP. | OLSWICK CS FEE #6 | STO,CBM | | | |
| P135940W | 43.56674000000 | -105.78280000000 | YATES PETROLEUM CORP. | OLSWICK CS FEE #7 | STO,CBM | | | |
| P135941W | 43.57045000000 | -105.77270000000 | YATES PETROLEUM CORP. | OLSWICK CS FEE #8 | STO,CBM | | | |
| P136024W | 43.61758000000 | -105.80760000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 13 S-1 | STO,CBM | 25 | 1284 | 849 |
| P136025W | 43.61384000000 | -105.81270000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 13 S-7 | STO,CBM | 25 | 1313 | 952 |
| P136026W | 43.61029000000 | -105.80760000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 13 S-9 | STO,CBM | 25 | 1251 | 902 |
| P136028W | 43.61007000000 | -105.82810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 14 S- 9 | STO,CBM | 25 | 1205 | 755 |
| P136029W | 43.61039000000 | -105.83870000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 14 S- 11 | STO,CBM | 25 | 1203 | 739 |
| P136030W | 43.60686000000 | -105.84400000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 14 S- 13 | STO,CBM | 25 | 1220 | 500 |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P136031W | 43.60656000000 | -105.83350000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 14S- 15 | STO,CBM | 25 | 1182 | 682 |
| P136032W | 43.60275000000 | -105.82820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 23 S- 1 | STO,CBM | 25 | 1272 | 343 |
| P136033W | 43.59924000000 | -105.83330000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 23 S- 7 | STO,CBM | 25 | 1280 | 404 |
| P136034W | 43.59544000000 | -105.82810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 23 S- 9 | STO,CBM | 25 | 1346 | 462 |
| P136035W | 43.59193000000 | -105.83310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 23 S- 15 | STO,CBM | 25 | 1295 | 775 |
| P136036W | 43.60304000000 | -105.80770000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 24 S- 1 | STO,CBM | 25 | 1200 | 731 |
| P136037W | 43.59932000000 | -105.81280000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 24S- 7 | STO,CBM | 25 | 1234 | 734 |
| P136038W | 43.59583000000 | -105.80770000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 24 S- 9 | STO,CBM | 25 | 1185 | 716.47 |
| P136039W | 43.59208000000 | -105.81280000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 24 S- 15 | STO,CBM | 25 | 1218 | 874 |
| P136040W | 43.58812000000 | -105.82810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 26S- 1 | STO,CBM | 25 | 1255 | 1073 |
| P136041W | 43.58455000000 | -105.83310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 26 S- 7 | STO,CBM | 25 | 1280 | 390 |
| P136042W | 43.57714000000 | -105.83310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 26 S- 15 | STO,CBM | 25 | 1260 | 800 |
| P136043W | 43.54089000000 | -105.87310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER 9S-7 | STO,CBM | 25 | 1050 | 356 |
| P136044W | 43.54456000000 | -105.84810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER 10S-1 | STO,CBM | 25 | 1086 | 839 |
| P136045W | 43.54454000000 | -105.85810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER 10S-3 | STO,CBM | 25 | 1076 | 746 |
| P136046W | 43.53724000000 | -105.84810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WI MOORE 10S-9 | STO,CBM | 25 | 971 | 625 |
| P136047W | 43.53720000000 | -105.85810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WI MOORE 10S-11 | STO,CBM | 25 | 1032 | 755 |
| P136048W | 43.53349000000 | -105.86310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WI MOORE 10S-13 | STO,CBM | 25 | 1062 | 778 |
| P136049W | 43.53354000000 | -105.85310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WI MOORE 10S-15 | STO,CBM | 25 | 1024 | 700 |
| P136050W | 43.52245000000 | -105.87810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-11 | STO,CBM | 25 | 1162 | 390 |
| P136051W | 43.54087000000 | -105.86310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER 10S-5 | STO,CBM | 25 | 1131 | 390 |
| P136052W | 43.52979000000 | -105.86810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-1 | STO,CBM | 25 | 905 | 264 |
| P136053W | 43.52984000000 | -105.87810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-3 | STO,CBM | 25 | 1044 | 941 |
| P136054W | 43.52617000000 | -105.88310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-5 | STO,CBM | 25 | 1176 | 329 |
| P136055W | 43.52611000000 | -105.87310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-7 | STO,CBM | 25 | 1107 | 562 |
| P136057W | 43.51879000000 | -105.88310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE WI MOORE 16S-13 | STO,CBM | 25 | 1184 | 503 |
| P136058W | 43.54820000000 | -105.86310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE (WALKER) 3S-13 | STO,CBM | 25 | 1142 | 300 |
| P136060W | 43.53351000000 | -105.87310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WI MOORE 9S-15 | STO,CBM | | | |
| P136061W | 43.54089000000 | -105.85310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WI MOORE 10S-7 | STO,CBM | 25 | 1064 | 390 |
| P137057W | 43.58488000000 | -105.78800000000 | YATES PETROLEUM CORP. | MCCONNELL CS FEE #1 | STO,CBM | | | |
| P137058W | 43.58490000000 | -105.79290000000 | YATES PETROLEUM CORP. | McCONNELL CS FEE #2 | STO,CBM | | | |
| P137059W | 43.58123000000 | -105.78800000000 | YATES PETROLEUM CORP. | McCONNELL CS FEE #3 | STO,CBM | | | |
| P137060W | 43.57758000000 | -105.79290000000 | YATES PETROLEUM CORP. | McCONNELL CS FEE #4 | STO,CBM | | | |
| P137785W | 43.56663000000 | -105.79790000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | STATE ARCHIBALD 31S-11 | STO,CBM | 25 | 1038 | 526 |
| P137786W | 43.56643000000 | -105.84810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 34S-9 | STO,CBM | 25 | 1188 | 390 |
| P137787W | 43.56284000000 | -105.85310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 34S-15 | STO,CBM | 25 | 1146 | 598 |
| P137788W | 43.56282000000 | -105.86310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 34S-13 | STO,CBM | 25 | 1161 | 408.92 |
| P137789W | 43.56643000000 | -105.85810000000 | IBERLIN RANCH PARTNERSHIP** DEVON EN | IBERLIN 34S-11 | STO,CBM | 25 | 1215 | 673 |
| P139473W | 43.54822000000 | -105.85310000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | WALKER FEDERAL 3S-15 | STO,CBM | | | |
| P140449W | 43.60319000000 | -105.76740000000 | YATES PETROLEUM CORP. | STEVE CS FEE #1 | STO,CBM | | | |
| P140450W | 43.59952000000 | -105.77260000000 | YATES PETROLEUM CORP. | STEVE CS FEE #2 | STO,CBM | | | |
| P140455W | 43.55963000000 | -105.75770000000 | YATES PETROLEUM CORP. | DIETZ CS FEE #1 | STO,CBM | | | |
| P140456W | 43.55593000000 | -105.76270000000 | YATES PETROLEUM CORP. | DIETZ CS FEE #2 | STO,CBM | | | |
| P140457W | 43.55228000000 | -105.75760000000 | YATES PETROLEUM CORP. | DIETZ CS FEE #3 | STO,CBM | | | |
| P140458W | 43.54859000000 | -105.76260000000 | YATES PETROLEUM CORP. | DIETZ CS FEE #4 | STO,CBM | | | |
| P144387W | 43.59222000000 | -105.79290000000 | YATES PETROLEUM CORPORATION | OLSWICK CS FEE # 4 | STO,CBM | | | |
| P145923W | 43.61058000000 | -105.87900000000 | WY STATE BOARD OF LAND COMMISSIONERS | STATE(T CHAIR) 16S-11 | STO,CBM | | | |
| P149130W | 43.57755000000 | -105.80290000000 | YATES PETROLEUM CORPORATION | CRITTENDON CS FEDERAL #4 | STO,CBM | | | |
| P150093W | 43.58494000000 | -105.80280000000 | YATES PETROLEUM CORPORATION | CRITTENDON CS FEDERAL # 2 | STO,CBM | | | |
| P150371W | 43.56304000000 | -105.79290000000 | YATES PETROLEUM CORPORATION | SIOUX CS FEDERAL # 2 | STO,CBM | 200 | 1048 | 811 |
| P150372W | 43.59949000000 | -105.80270000000 | YATES PETROLEUM CORPORATION | CAVALRY CS FEDERAL # 2 | STO,CBM | | | |
| P150373W | 43.59228000000 | -105.80280000000 | YATES PETROLEUM CORPORATION | CAVALRY CS FEDERAL # 4 | STO,CBM | | | |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P152613W | 43.57051000000 | -105.76260000000 | YATES PETROLEUM CORP. | LOOK CS #1 | STO,CBM | 200 | 871 | 699 |
| P154203W | 43.61038000000 | -105.78790000000 | YATES PETROLEUM CORP. | PRATHER CS #1 | STO,CBM | 200 | 1202 | 851 |
| P154204W | 43.61035000000 | -105.79780000000 | YATES PETROLEUM CORP. | PRATHER CS #2 | STO,CBM | 200 | 1239 | 1002 |
| P154205W | 43.60671000000 | -105.80270000000 | YATES PETROLEUM CORP. | PRATHER CS #3 | STO,CBM | 200 | 1185 | 941 |
| P154207W | 43.59947000000 | -105.79290000000 | YATES PETROLEUM CORP. | OLSWICK CS FEE #2 | STO,CBM | 200 | 1038 | 877 |
| P155673W | 43.63224000000 | -105.82820000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | COSNER 11S-1 | STO,CBM | 25 | 1269 | 500 |
| P155674W | 43.63243000000 | -105.83900000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | COSNER 11S-3 | STO,CBM | 25 | 1222 | 384 |
| P155675W | 43.62888000000 | -105.84400000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | COSNER 11S-5 | STO,CBM | 25 | 1192 | 404 |
| P155676W | 43.62479000000 | -105.82810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 11S-9 | STO,CBM | 25 | 1231 | 583 |
| P155677W | 43.62510000000 | -105.83880000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 11S-11 | STO,CBM | 25 | 1192 | 534 |
| P155678W | 43.62162000000 | -105.84390000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 11S-13 | STO,CBM | 25 | 1194 | 708 |
| P155679W | 43.62864000000 | -105.83360000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | COSNER 11S-7 | STO,CBM | 25 | 1226 | 454 |
| P155680W | 43.62126000000 | -105.83340000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN 11S-15 | STO,CBM | 25 | 1232 | 630 |
| P155710W | 43.60681000000 | -105.77260000000 | WILLIAMS PRODUCTION RMT COMPANY | ANCU NINE MILE LAND 34-17-4274 | STO,CBM | 17 | 1120 | 769 |
| P158876W | 43.57762000000 | -105.78290000000 | YATES PETROLEUM CORP. | BIGHORN CS FEDERAL #4 | STO,CBM | | | |
| P159666W | 43.61405000000 | -105.78280000000 | WILLIAMS PRODUCTION RMT COMPANY | ANCU 12-17-4274 | STO,CBM | 13 | 1195 | 928 |
| P159667W | 43.60675000000 | -105.78290000000 | WILLIAMS PRODUCTION RMT COMPANY | ANCU 14-17-4274 | STO,CBM | 13 | 1093 | 1027 |
| P159669W | 43.61043000000 | -105.77770000000 | WILLIAMS PRODUCTION RMT COMPANY | ANCU 23-17-4274 | STO,CBM | 15 | 1160 | 1050 |
| P159678W | 43.59225000000 | -105.76250000000 | WILLIAMS PRODUCTION RMT COMPANY | ANCU 14-21-4274 | STO,CBM | | | |
| P161016W | 43.61739000000 | -105.82810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 14S-1 | STO,CBM | 25 | 1251 | 835 |
| P161017W | 43.60638000000 | -105.82300000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 13S-13 | STO,CBM | 25 | 1222 | 1102 |
| P161018W | 43.61011000000 | -105.81780000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 13S-11 | STO,CBM | 25 | 1218 | 940 |
| P161019W | 43.61368000000 | -105.82290000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 13S-5 | STO,CBM | 25 | 1299 | 1006 |
| P161020W | 43.61741000000 | -105.81780000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 13S-3 | STO,CBM | 25 | 1271 | 949 |
| P161021W | 43.62116000000 | -105.81270000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDERAL 12S-15 | STO,CBM | 25 | 1305 | 930 |
| P161026W | 43.61777000000 | -105.83870000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDEAL 14S-3 | STO,CBM | 25 | 1190 | 786 |
| P161027W | 43.61426000000 | -105.84400000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDEAL 14S-5 | STO,CBM | 25 | 1260 | 770 |
| P161028W | 43.61390000000 | -105.83340000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDEAL 14S-7 | STO,CBM | 25 | 1195 | 804 |
| P161029W | 43.58447000000 | -105.82300000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDEAL 25S-5 | STO,CBM | 25 | 1178 | 1017 |
| P161030W | 43.58858000000 | -105.84810000000 | DEVON ENERGY PRODUCTION COMPANY, L.P | IBERLIN FEDEAL 27S-1 | STO,CBM | 25 | 1231 | 775 |
| P161649W | 43.53725000000 | -105.83810000000 | BILL BARRETT CORPORATION | WALKER CREEK 23-11-4175 | STO,CBM | | | |
| P161650W | 43.54091000000 | -105.83310000000 | BILL BARRETT CORPORATION | MOORE WIRC 32-11-4175 | STO,CBM | | | |
| P161651W | 43.54457000000 | -105.83810000000 | BILL BARRETT CORPORATION | WALKER CREEK 21-11-4175 | STO,CBM | | | |
| P161652W | 43.53725000000 | -105.83310000000 | BILL BARRETT CORPORATION | MOORE WIRC 33-11-4175 | STO,CBM | | | |
| P164090W | 43.50443000000 | -105.82300000000 | BILL BARRETT CORPORATION | MOORE WIRC 14-24-4175 | STO,CBM | | | |
| P164238W | 43.55562000000 | -105.91850000000 | BILL BARRETT CORPORATION | IBERLIN 22-6-4175 | STO,CBM | | | |
| P164239W | 43.55561000000 | -105.91340000000 | BILL BARRETT CORPORATION | IBERLIN 32-6-4175 | STO,CBM | | | |
| P164240W | 43.54462000000 | -105.91850000000 | BILL BARRETT CORPORATION | IBERLIN 21-7-4175 | STO,CBM | | | |
| P164241W | 43.54094000000 | -105.91340000000 | BILL BARRETT CORPORATION | IBERLIN 32-7-4175 | STO,CBM | | | |
| P164242W | 43.53730000000 | -105.92370000000 | BILL BARRETT CORPORATION | IBERLIN 33-7-4175 | STO,CBM | | | |
| P164243W | 43.54094000000 | -105.91340000000 | BILL BARRETT CORPORATION | IBERLIN 42-7-4175 | STO,CBM | | | |
| P164244W | 43.53725000000 | -105.90830000000 | BILL BARRETT CORPORATION | IBERLIN 43-7-4175 | STO,CBM | | | |
| P164245W | 43.54092000000 | -105.90320000000 | BILL BARRETT CORPORATION | IBERLIN 12-8-4175 | STO,CBM | | | |
| P166781W | 43.50788000000 | -105.88840000000 | BILL BARRETT CORPORATION | OGALALLA LAND 43-20-4175 | STO,CBM | | | |
| P166783W | 43.50078000000 | -105.82810000000 | BILL BARRETT CORPORATION | MOORE WIRC 41-26-4175 | STO,CBM | | | |
| P167682W | 43.55196000000 | -105.91850000000 | BILL BARRETT CORPORATION | IBERLIN 23-6-4175 | STO,CBM | | | |
| P167683W | 43.52255000000 | -105.90840000000 | BILL BARRETT CORPORATION | IBERLIN 43-18-4175 | STO,CBM | | | |
| P167684W | 43.54830000000 | -105.92370000000 | BILL BARRETT CORPORATION | IBERLIN 14-6-4175 | STO,CBM | | | |
| P167685W | 43.52625000000 | -105.91350000000 | BILL BARRETT CORPORATION | IBERLIN 32-18-4175 | STO,CBM | | | |
| P167686W | 43.52990000000 | -105.90830000000 | BILL BARRETT CORPORATION | IBERLIN 41-18-4175 | STO,CBM | | | |
| P167687W | 43.51886000000 | -105.90340000000 | BILL BARRETT CORPORATION | IBERLIN 14-17-4175 | STO,CBM | | | |
| P167688W | 43.52621000000 | -105.90330000000 | BILL BARRETT CORPORATION | IBERLIN 12-17-4175 | STO,CBM | | | |

| PERMIT | LATITUDE | LONGITUDE | APPLICANT | FACILITY NAME | USES | YIELD | WELL DEPTH | STATIC DEPTH |
|---|---|---|---|---|---|---|---|---|
| P167689W | 43.54828000000 | -105.91340000000 | BILL BARRETT CORPORATION | IBERLIN 34-6-4175 | STO,CBM | | | |
| P167789W | 43.51893000000 | -105.84320000000 | BILL BARRETT CORPORATION | FEDERAL 14-14-4175 | STO,CBM | | | |
| P167790W | 43.52259000000 | -105.83820000000 | BILL BARRETT CORPORATION | FEDERAL 23-14-4175 | STO,CBM | | | |
| P167791W | 43.52625000000 | -105.83310000000 | BILL BARRETT CORPORATION | FEDERAL 32-14-4175 | STO,CBM | | | |
| P167792W | 43.51892000000 | -105.83310000000 | BILL BARRETT CORPORATION | FEDERAL 34-14-4175 | STO,CBM | | | |
| P167793W | 43.52991000000 | -105.82810000000 | BILL BARRETT CORPORATION | FEDERAL 41-14-4175 | STO,CBM | | | |
| P167794W | 43.52258000000 | -105.82810000000 | BILL BARRETT CORPORATION | FEDERAL 43-14-4175 | STO,CBM | | | |
| P167795W | 43.51871000000 | -105.86310000000 | BILL BARRETT CORPORATION | FEDERAL 14-15-4175 | STO,CBM | | | |
| P167796W | 43.52246000000 | -105.85810000000 | BILL BARRETT CORPORATION | FEDERAL 23-15-4175 | STO,CBM | | | |
| P167797W | 43.51884000000 | -105.85320000000 | BILL BARRETT CORPORATION | FEDERAL 34-15-4175 | STO,CBM | | | |
| P167798W | 43.52257000000 | -105.84820000000 | BILL BARRETT CORPORATION | FEDERAL 43-15-4175 | STO,CBM | | | |
| P167799W | 43.51166000000 | -105.84320000000 | BILL BARRETT CORPORATION | FEDERAL 12-23-4175 | STO,CBM | | | |
| P167800W | 43.50440000000 | -105.84320000000 | BILL BARRETT CORPORATION | FEDERAL 14-23-4175 | STO,CBM | | | |
| P167801W | 43.51528000000 | -105.83820000000 | BILL BARRETT CORPORATION | FEDERAL 21-23-4175 | STO,CBM | | | |
| P167802W | 43.50803000000 | -105.83820000000 | BILL BARRETT CORPORATION | FEDERAL 23-23-4175 | STO,CBM | | | |
| P167803W | 43.51165000000 | -105.83310000000 | BILL BARRETT CORPORATION | FEDERAL 32-23-4175 | STO,CBM | | | |
| P167804W | 43.50440000000 | -105.83310000000 | BILL BARRETT CORPORATION | FEDERAL 34-23-4175 | STO,CBM | | | |
| P167805W | 43.51526000000 | -105.82810000000 | BILL BARRETT CORPORATION | FEDERAL 41-23-4175 | STO,CBM | | | |
| P167806W | 43.50802000000 | -105.82810000000 | BILL BARRETT CORPORATION | FEDERAL 43-23-4175 | STO,CBM | | | |
| P167807W | 43.51177000000 | -105.81290000000 | BILL BARRETT CORPORATION | FEDERAL 32-24-4175 | STO,CBM | | | |
| P167808W | 43.51545000000 | -105.80780000000 | BILL BARRETT CORPORATION | FEDERAL 41-24-4175 | STO,CBM | | | |
| P167810W | 43.50077000000 | -105.83820000000 | BILL BARRETT CORPORATION | FEDERAL 21-26-4175 | STO,CBM | | | |

## 2.3 POPULATION DISTRIBUTION

Information presented in this section concerns those demographic and social characteristics of the counties and communities that may be affected by the proposed development of a uranium in-situ recovery facility at the Moore Ranch Project in Campbell County, Wyoming. Data were obtained through the 1980, 1990, and 2000 U.S. Census of Population, the 2005 and 2006 Census Population Estimates program, and various State of Wyoming government agencies.

### 2.3.1 Demography

#### 2.3.1.1 Regional Population

The area within an 80-kilometer (km) (50-mile) radius of the Moore Ranch License Area (License Area) includes portions of six counties in northeastern Wyoming (Campbell, Converse, Johnson, Natrona, Weston Counties and a small portion of Niobrara County), as shown on Figure 2.3-1 (all Tables and Figures are included at end of this Section). The proposed Moore Ranch Project is located in southwest Campbell County. The nearest communities are Wright, a small Campbell County incorporated town located northeast on State Highway 387, and the Towns of Edgerton and Midwest, which are located in Natrona County southwest of the Moore Ranch Project on State Highway 387.

Historical and current population trends in counties and communities within an 80 km distance of the Project are shown in Table 2.3-1, which summarize past growth trends in the counties relative to state population trends between 1980 and 2006. The largest growth rates in the six-county region since 2000 occurred in Johnson, Natrona, and Campbell Counties, primarily because of ongoing mineral resource development in the Powder River Basin. Population growth in Campbell, Johnson, and Converse Counties has outpaced state population growth for most years since 1980, with the largest average annual growth rate of 13.7 percent occurring in Converse County during the 1980s. The state population declined during this period, primarily because of declines in historic agricultural economic sectors, while the high growth rates in Campbell, Johnson, and Converse Counties indicated boom years in oil, coal, and gas development. The population in Campbell County grew at a slower rate between 2000 and 2006 than in previous decades, so that growth rates are more in line with the state growth rates. The overall county and state economies are more diverse in the current decade than they were during the 1980s.

### 2.3.1.2 Population Characteristics

2005 population by age and sex for counties within 80 km of the License Area is shown in Table 2.3-2. Overall, the 40- to 64-year age group (which includes the 'baby boom' cohort) is the largest age group in each of the counties. According to the Wyoming Economic and Demographic Forecast: 2005 to 2014 (Wyoming Economic Analysis Division 2005), the early baby boom population in Wyoming is one of the highest in the nation as a result of the in-migration of workers during the oil boom years in the late 1970s and early 1980s. In contrast, the population in the 27- to 42-year age group is relatively low because there was a high net out-migration (outflow greater than inflow) in this age group between 1995 and 2000 as young adults left the state during a declining economy. The aging population is expected to affect the economy through changes in the labor supply as retiring baby boomers reach retirement age and are replaced by fewer new workers. The older population would also require different types of goods and services, requiring a shift in local economic sectors to accommodate the changing demographics.

In 2005, 96.9 percent of the six-county population was classified as white. Native American and persons of Hispanic origin comprised 1.1 percent and 4.4 percent, respectively, of the total six-county population of 136,541. The populations in all other racial categories account for less than 1 percent of the total population. The racial characteristics of each county were similar to the racial characteristics of the state.

### 2.3.1.3 Population Projections

The projected populations for selected years by county within the 80 km radius of the proposed License Area are shown in Table 2.3-3. The population projections between 2000 and 2020 anticipate that the relatively stable population trends evident between 2000 and 2006 will continue for the county and the state. The projected population growth in Campbell and Johnson Counties will continue to outpace population growth in the state, in response to ongoing and potential new mineral development projects located in these counties. The populations of Niobrara and Weston Counties will experience very slow growth or declines in population, indicating that these counties are not anticipated to see in-migrations of new residents seeking employment in the mineral development of nearby counties. It is not expected that there will be the large in-migrations of population that were typical of the 1980s.

### 2.3.1.4 Seasonal Population and Visitors

The proposed License Area consists of private lands in southwest Campbell County. The surrounding area within an 80 km (50-mile) radius contains mostly private lands, but also federal and state lands, which provide open space for a variety of dispersed outdoor recreation opportunities. No developed recreation opportunities are provided on federal and state lands within the 80 km radius. Recreation opportunities offered by the private sector consist of community facilities in urban areas and the infrastructure of tourist services and facilities.

The closest recreational facility that would be a destination for tourists to the License Area is the Bozeman Trail, which crosses State Highway 387 about 1 mile west of the License Area. Visitation statistics are not compiled for the trail. Approximately 41,500 people visited the Edness Kimball Wilkins State Park (55 miles SSW of the License Area and 5 miles east of Casper) in 2005, which was a decrease of 50 percent from the 84,109 people who visited the park in 2001. Visits to the park were the lowest in 2005 for the years 1998 through 2005 (WDAI EAD 2005). Comparison of the park visitor fluctuations over this period with other parks and facilities in northeast Wyoming did not reveal a trend or pattern that would account for the annual fluctuations.

The Thunder Basin National Grassland is 14 miles east of the east boundary of the License Area. The most popular recreation use category is motorized travel/viewing scenery. Hunting and camping are also popular. Recreation use accounted for an average of 64,100 Recreation Visitor Days annually between 1992 and 1996. There are no developed recreation facilities on the Thunder Basin National Grassland.

A primary source of seasonal population in the six-county area is short-term labor for mineral resource development, construction, and service industries engaged in tourism/recreation. A review of reports prepared by the Wyoming Economic Analysis Division indicates that these workers are most likely to relocate temporarily from neighboring counties and states including Montana, Nebraska, Colorado, and South Dakota. The seasonal labor force for these economic sectors is not included in any available population or labor force data for the counties.

#### 2.3.1.5 Schools

The License Area is located within Campbell County School District 1, which serves all of Campbell County. The nearest Campbell County community that provides education services to residents in the vicinity of the License Area is Wright, which is located 22 miles northeast of the License Area on State Highway 387. Two schools are located in Wright. The Cottonwood Elementary School serves kindergarten through grade 6. Total enrollment in these two schools for the 2005-2006 school year was 228 in the elementary school and 228 in the junior – senior high school (Wyoming Department of Education 2007). Enrollment in the elementary school has increased by 30 students since the 2001-2002 school year enrollment of 198 in the elementary school. Enrollment in the high school has decreased by 39 from the 2001-2002 enrollment of 267. The elementary school currently has a student to teacher ratio of 12.5 to 1 while the high school has a ratio of 9.7 to 1.

In Natrona County, the Midwest School provides classes for students from preschool through grade 12. Enrollment for the 2005-2006 school year was 229. The school has a student to teacher ratio of 9.4 to 1.

Families moving into the Natrona and Campbell County school districts as a result of the proposed Moore Ranch License Area operations would not stress the current school system because it is presently under capacity.

2.3.1.6 Sectorial Population

Existing population within the 80 km radius centered on the License Area was estimated for 16 compass sectors, by concentric circles of 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70 and 80 km from the center of the proposed License Area, for a total of 208 sectors. Sectorial population was estimated with data from the U.S. Census Bureau's Population Estimates Program. Subtotals by sector and compass points, as well as the total population, are shown in Table 2.3-4.

The most recent available population data were acquired from Geographic Data Technology, Inc., a division of the Environmental Systems Research Institute (ESRI). The data were created using U.S. Census 2000 boundary and demographic information for block groups within the United States, and intercensal population estimates for 2004 from the Population Estimates Program.

ArcInfo Geographic Information System (GIS) was used to extract data from U.S. Census 2004 population estimates for Census Tract Block Groups located wholly or partially within the 80 km radius from the approximate center of the License Area. Urban areas within each county were generally assigned their own block groups. To assign a population to each sector, a percentage area of each sector within one or more block groups was calculated for all of the block groups. The total 2004 population within the 80 km radius from the center of the License Area estimated by this method was 28,092.

The sectorial populations calculated using the percentage areas were modified for the sectors within a 20-mile distance because the GIS calculations are averages that do not accurately reflect the distribution of urban and rural populations within the 20-mile (32 km) radius. In addition, some sectors throughout the 80 km radius contain mostly Bureau of Land Management (BLM)-administered federal lands and do not contain any residents. These sectors were assigned a zero population. Most of the area within the 80 km radius is rural, with the majority of the population residing in the small communities near the License Area or in larger urban areas in the sectors farthest from the License Area center. Urban areas include the towns of Wright, located 22.0 miles (35.4 km) to the northeast of the License Area; Edgerton, located 23.6 miles (38.0 km) to the west-southwest; and Midwest, located 25.0 miles (40.2 km) west-southwest.

The City of Glenrock is located in the 70 to 80 km sector south of the License Area. The Census Designated Places of Antelope Hill and Homa Hills are located to the southwest along I-25, between 60 to 80 km (37.3 to 50 miles). The south part of the City of Gillette that is within the 80 km radius area consists of Census Tract 2, Block Group 2.

The population within 2 miles of the License Area boundary was estimated by locating occupied residences within 2 miles using 2006 aerial photos and field reconnaissance. The U.S. Census 2000 blocks (blocks are subdivisions of block groups) included in this area were reviewed for the total number of people residing within housing units within the blocks. There are no individual block data available for the intercensal years of the U.S. Census Population Estimates Program.

The total population within the 80 km radius was estimated to be 27,987 once individual sectors were modified to better represent the distribution of urban and rural populations within the area (Table 2.3-4). This total varied less than 1 percent (105 people) from the total population of 28,092 people that was calculated using GIS percentage calculations in the unmodified table.

### 2.3.2 Local Socioeconomic Characteristics

#### 2.3.2.1 Major Economic Sectors

The Moore Ranch License Area is located in Campbell County; however, social and economic characteristics are described for Natrona in addition to Campbell County because communities in Natrona County, primarily the City of Casper, provide a relatively large resident labor force for mineral extraction and construction industries in northeast Wyoming. A substantial portion of the project labor force is likely to be based in Natrona County, primarily residing in the City of Casper. Table 2.3-5 summarizes unemployment rates and employment in Campbell and Natrona Counties.

The economies of Campbell County and Natrona County depend on the energy sector, primarily those that are mineral-based. The largest employment sector in Campbell County is mining, which includes coal mining, oil and gas extraction, crude, petroleum-natural gas, oil and gas field service, and nonmetallic minerals as defined by the U.S. Bureau of Labor Statistics.

A report prepared by the Wyoming Department of Employment, Research and Planning analyzes labor supply in Wyoming by place of residence. The analysis concluded that a portion of the available labor pool in Wyoming consists of non-residents. According to the report, the construction sector is one of the industries most dependent upon seasonal and short-term workers. Of all persons working in heavy construction in 2000, 38.4 percent did not work in Wyoming in 1999.

Table 2.3-5 also shows the labor force characteristics in Campbell and Natrona Counties in 2005. In general, unemployment rates were highest in the early 1990s and have decreased overall by 2005 because of renewed energy development in northeastern Wyoming. Annual fluctuations in unemployment rates are driven primarily by short-term changes in production due to changing prices for coal, oil, and coal bed methane gas.

Per capita personal income is the income that is received by persons from all sources, including wages and other income over the course of 1 year. In 2005, personal income in Campbell County was $37,318, which was 109 percent of the state average of $34,371. The county ranks sixth in per capita annual income out of 23 counties in the state (BEA 2004). Natrona County had a higher per capita income of $41,462, which was 120 percent of the state average and ranked third in the state. Most of the Wyoming counties with the highest per capita personal incomes have strong mineral development economic sectors.

#### 2.3.2.2 Housing

The nearest permanent housing is located in the communities of Wright in Campbell County, and Midwest and Edgerton in Natrona County. According to the U.S. Census 2000 (the most recent year for which housing data were available for communities), there were 544 housing units in Wright. Of these units, the average occupancy rate was 87.3 percent, including 114 renter-occupied housing units. The vacancy rate for all types of housing units was 12.7 percent.

In Natrona County, there were 119 housing units in Edgerton, of which 74 units were occupied. The number of occupied rental units was 17. The vacancy rate was 37.8 percent. In nearby Midwest, 149 of the total 228 housing units were occupied. There were 32 renter-occupied and 79 vacant housing units.

It is likely that current vacancy rates in Wright, Edgerton, and Midwest will decrease as a result of insufficient housing stock and increasing in-migration of workers for employment in ongoing mineral resource development. A rental vacancy survey summarized in the Wyoming Community Development Authority report (2007) shows that rental vacancy rates in Natrona County decreased to 1.67 percent (Table 2.3-6) from a post-U.S. Census 2000 high of 4.49 percent in 2002. A similar decrease in rental vacancy rates occurred in the same time period in Converse County, from a high of 3.66 percent in 2002 to the 2006 rate of 0.42 percent. The influx of population in these counties as a result of economic growth stimulated by coal bed methane gas and coal production has outstripped the available housing supply.

Urban areas within Campbell and Natrona Counties are generally within a 1- to 2-hour commuting distance from the proposed License Area. Rural areas in the counties are sparsely populated, so that most of the housing units characterized in Table 2.3-6 are located within the communities of Gillette (Campbell County), Casper (Natrona County), and other smaller communities located along the I-25 corridor through Natrona County. Table 2.3-6 also includes the total number of housing units in the counties, but focuses on rental characteristics because most of the labor force that would originate from outside of Campbell and Natrona Counties would likely reside in rental units and other temporary lodging.

The household forecast (a household is defined as all the persons who occupy a housing unit) project an increase of 18,171 households in Campbell County from 12,207 in 2000 to 30,378 in 2030. The number of renters in Campbell County is projected to increase from 3,218 in 2000 to 7,271 in 2030. In Natrona County, the number of households is projected to increase by 19,650, from 26,819 in 2000 to 46,469 by 2030. The number of renters is expected to increase from 8,079 in 2000 to 11,831 in 2030.

2.3.2.3 Temporary Housing

Temporary housing options in the vicinity of the License Area include hotels, motels, and campgrounds. Vacancy rates are not currently available for temporary accommodations in Campbell and Natrona Counties. Available local motels/hotels/cabin establishments in the region generally have low vacancy rates during hunting seasons. There is also a high level of occupancy by the coal bed methane gas industry workers. Many motels and recreational vehicle (RV) campgrounds in the region provide accommodation for long-term visits by the week or month.

The temporary lodgings closest to the License Area are in Wright and Edgerton. Accommodations in Wright include a mobile home park, a hotel, an RV park, and one apartment complex (Town of Wright 2007). One motor lodge is located in Edgerton.

Casper and Glenrock, both on the I-25 corridor south of the License Area, provide numerous temporary lodging options (Casper Chamber of Commerce 2007). There are 28 motel/hotels in Casper and nine RV parks/campgrounds in the vicinity of Casper. Glenrock provides lodging in two motels and one RV park.

There are 18 hotels in Gillette, with a total capacity of 1,420 rooms. In addition, the two campgrounds in the Gillette area provide RV hookups and tent sites. The Cam-Plex is funded by Gillette and Campbell County, and may not compete with private enterprise (Barks 2005). The additional 1,821 RV sites at the Cam-Plex are available only for special events and not for the general public.

Temporary lodging is also available in the Town of Kaycee (located approximately 40 miles west of the License Area) in Johnson County and Sundance (located 60 miles east of Gillette) in Crook County. Temporary lodging facilities include two motels and two RV parks, which also provide tent sites and cabin rentals.

### 2.3.3 Evaluation of Socioeconomic Impacts

The construction and operating work force for the Moore Ranch project is anticipated to come from the region surrounding the License Area, primarily Campbell and Natrona Counties in northeastern Wyoming. At least 50 percent of the work force would likely be located in Gillette, which provides labor for a number of large-scale energy related projects in the region. The proposed project is located in Campbell County, which would be most likely to experience effects to housing, public and other community services, recreation, county and municipal finances, crime, and the local transportation network. The adjacent Natrona County would also experience effects to housing and community services, as some of the project workforce would likely reside in Natrona County communities.

It is anticipated that the overall effect of the proposed facility operations on the local and regional economy would be beneficial. Purchases of goods and services by the mine and mine employees would contribute directly to the economy. Local, state, and the federal governments would benefit from taxes paid by the mine and its employees. Indirect impacts, resulting from the circulation and recirculation of direct payments through the economy, would also be beneficial. These economic effects would further stimulate the economy, resulting in the creation of additional jobs. Beneficial impacts to the local and regional economy provided by the proposed Moore Ranch operation would continue for the life of the facility, estimated to be 10 years for the well field operation and 25 years for the central plant operations as of June 2007. Economic impacts of the proposed operation are discussed in detail in Section 9.

#### 2.3.3.1 Construction

The construction phase would cause a moderate impact to the local economy, resulting from the purchases of goods and services directly related to construction activities. Impacts to community services in rural Campbell County or the nearby towns of Midwest and Edgerton in Natrona County, and Wright in Campbell County, such as roads, housing, schools, and energy costs would be minor or non-existent and temporary.

An estimated 50 percent (25 workers) of the construction work force would be based in Campbell County, which contains the project site. The workforce hired outside of the County would likely be based in Casper, located in the neighboring Natrona County, as Casper is a regional economic hub that provides a variety of construction services and labor for projects located throughout Wyoming.

Most construction work available to the local construction labor pool consists of temporary contract work that varies in duration, depending on the scope of each construction project. Further, the number of unemployed construction workers does not represent the number of workers that would be available to the proposed project from the local construction labor pool. The number is an annual average that does not take into account monthly variations in the available construction labor pool from construction start-ups and completions. Contractors for projects located throughout northeastern Wyoming typically hire the local construction labor pool. The actual number of construction workers available for the proposed project would potentially draw from the entire construction labor pool of 6,268 (2005 estimate; the construction labor pool as of 2007 is likely to be larger), as construction activities from some active projects would conclude so that workers would be available for future projects.

2.3.3.2 Operations Workforce

An estimated 40 to 60 people would be required for the operation of the proposed Moore Ranch Project. It is not known how many of the required operations workforce would be hired from outside of Campbell and Natrona Counties. In the event that the entire operations workforce and their families relocated to the counties, the population increase would be a maximum of 150, based on the 2005 average household size of 2.52 in Wyoming. This increase would account for 0.1 percent of the population of Campbell and Natrona Counties, and is smaller than the projected annual growth rate. Therefore, there would be little to no effect to the vacancy rates of any type of housing in Gillette area or Campbell County.

2.3.3.3 Effects to Housing

The License Area lies within commuting distance of Gillette and Wright, in Campbell County, and Casper in Natrona County, so that workers from these counties would likely commute from their homes. There would be no impact to temporary housing located within commuting distance (an estimated 1 to 2 hours) of the License Area.

In the event that workers from other states are hired for construction of the project, temporary housing such as motel/hotel rooms and RV sites located within commuting distance would be required, as no on-site housing (man camp) is planned. The available stock of motel/hotel rooms would accommodate relocating workers.

It is recognized, however, that the coal bed methane gas and mineral industries are presently a dominating factor for temporary housing availability in the area, and the workforce employed in these industries occupy much of the temporary housing that becomes available.

It is anticipated that few of the construction work force during any phase of the proposed project would purchase or rent housing of any type. Therefore, there would be no effects on the costs of any type of housing in the counties. Because rental housing usually require a long-term lease (generally a minimum of 6 months), only operations employees would likely enter into this type of lease agreement. Under a hiring scenario that assumes all of the proposed operations workforce would need to relocate to the area, 40 to 60 housing units would be required over the life of the project. In 2006, there were a total of 60 vacant housing units in Campbell and Natrona Counties, which would not meet the future demand for housing in the counties from anticipated population growth. Therefore, there would be little to no effect to the rental rates of any type of housing in Gillette or Campbell County.

Household projections estimate an increase in households from 2000 to 2030 as 140 percent in Campbell County and 73 percent in Natrona County. The existing housing stock would not accommodate the projected households. Local communities in general are aware of the pressing need for the new residential development.

#### 2.3.3.4 Effects to Services

It is likely that both the construction and operating work force would be from Campbell and Natrona Counties, or other nearby counties in northeast Wyoming, and would not require permanent or temporary housing. In the event that up to 50 percent of the construction and operating workforce are non-local workers, it is anticipated that there would be a less than one percent increase in the population of Campbell and Natrona Counties from the permanent relocation of the workers and their families. Most non-local workers would utilize temporary housing. Because existing mobile home and RV parks will be used for a majority of the temporary housing, the project will not require new water, sewer, electrical lines, or other infrastructure. There will be no additional demands of increases in service levels for local infrastructure, such as police, fire, water, or utilities. In addition, there would be little measurable increase in non-basic employment, as these jobs are generated from ongoing employment of the existing base of construction workers, and would be maintained through the continued employment of local construction workers. Therefore, construction and operation of the project would not significantly affect the various public and non-public facilities and services described above from the in-migration of workers for non-basic employment opportunities.

#### 2.3.3.5 Effects to Traffic

The most heavily used public road segment would be State Highway 387 between I-25 to the west and State Highway 59 to the east. Access to the License Area from Gillette would be from State Highway 59, and from Casper would be from I-25. Construction traffic, the construction workforce, and the operations workforce would converge on the License Area on State Highway 387 from the east and the west. The existing traffic levels on the highway are low. The highest levels of project-related traffic would be from the operations workforce, and assuming there would be an average of one employee per vehicle, per one-way vehicle trip, there could be an increase of 5.4 percent in daily traffic along the highway. This 5.4 percent (10.8 percent for two trips per day) increase is well below the 25 percent threshold generally used for predicting significant effects to a transportation system.

Equipment needed for construction and installation of the proposed facility would include heavy equipment (cranes, bulldozers, graders, track hoes, trenchers, and front-end loaders), and heavy- and light-duty trucks.

### 2.3.4 Environmental Justice

The U.S Census 2000 Decennial Population program provides race and poverty characteristics for Census Tracts and Block Groups, which are subdivisions of Census Tracts. The Moore Ranch License Area and the surrounding 2-mile buffer are contained within five Census Tracts and one additional Block Group that encompass portions of Campbell, Converse, Johnson, and Natrona Counties.

As summarized in Table 2.3-7, the combined population of the surrounding Census Tracts was 4,799. Minority populations accounted for a small percentage of the total population, with percentages of minorities generally similar to or smaller than those of the state as a whole.

The State of Wyoming was selected to be the geographic area to compare the demographic data for the population in the affected Census Tracts. This determination was based on the need for a larger geographic area encompassing affected area Census Tracts in which equivalent quantitative resource information is provided. The population characteristics of the affected Census Tracts are compared with Wyoming population characteristics to determine whether there are concentrations of minority or low-income populations in the Census Tracts relative to the state.

The data in Table 2.3-7 show that minority populations in the affected Tracts account for an overall smaller proportion of the population than the proportion of minority populations at the state level. No concentrations of minority populations were identified as residing near the proposed project facilities, as residents nearest to the License Area are rural populations, while most of the minority population lives in Gillette and communities along the I-25 corridor to the south. There would be no disproportionate impact to minority population from the construction and operation of the Moore Ranch Project.

With the exception of Census Tracts 9551 in Johnson County and 14.01 in Natrona County, the populations within the Tracts exhibit lower rates of people living below the poverty level than the state. Census Tracts 9551 and 14.01 contain rural populations; therefore, there is no concentration of people living below the poverty level in these Tracts. No disproportionate adverse environmental impacts would occur in populations living below the poverty level within the Census Tracts from proposed project activities.

### 2.3.5 References

Barks, D. 2005. Cam-Plex MultiEvent Facilities. Personal communication. [April 29 telephone conversation with Dan Banks,General Manager of Cam-Plex and L. Welch, Greystone Environmental Consultants, Greenwood Village, Colorado regarding the availability of RV sites for construction workers. Campbell County, Wyoming.

Bureau of Economic Analysis (BEA). 2004. 2002 Personal Income for Campbell County, Wyoming.

Casper Chamber of Commerce. 2007. [Web Page] Accommodations. http://www.casperwyoming.info/lodging.php. Accessed June 14, 2007.

National Center for Education Statistics. 2004. Public Schools, Midwest, Wyoming, located at www.nces.ed.gov

Natrona County School District. 2007. [Web Page] http://www.natronaschools.org/about/choice/midwest.pdf. Accessed on June 13, 2007.

North East Wyoming Economic Development Coalition (NEWEDC). 2005. Welcome to Converse County, Wyoming. [Web Page] http://www.newedc.net/converse/index.htm. Accessed June 14, 2007.

Town of Wright. 2007. Accommodations in the Town of Wright. [Web Page] http://www.wrightwyoming.com/. Accessed June 14, 2007.

U.S. Department of Commerce, Bureau of Census. 2000. Decennial Census of Population, Wyoming.

U.S. Department of Commerce, Bureau of Census. 2007. Population Estimates Program; 2000 – 2006.

U.S. Department of Commerce, Bureau of Census. 2007. 2005 Census Data on Population and Housing, Colorado Economic and Demographic Information System. Racial and Ethnic Composition, and Average Household Size. Link to U.S. Census Bureau, American Fact Finder. [Web Page] located at: http://factfinder.census.gov/servlet/DTTable?_ts=35204832296. Accessed: May 2001.

Wyoming Agricultural Statistics Service. 2001. Wyoming Agricultural Statistics 2000-2001, August.

Wyoming Community Development Authority. 2007. Profile of Wyoming Demographics, Economics and Housing; Semiannual Report, Ending December 31, 2006. Volume I Final Report Sponsored by the Wyoming Housing Database Partnership, February 2007. [Web Page] http://www.wyomingcda.com/Homebuyer/Home_Demographics.html. Accessed on June 13, 2007.

Wyoming Department of Administration and Information (WDAI), Economic Analysis Division (EAD). 2004. Wyoming Population Estimates and Forecasts from 1991 to 2010.

WDAI EAD. 2005. 10 Year Outlook Wyoming Economic and Demographic Forecast 2005 to 2014. [Web page] http://eadiv.state.wy.us. Accessed on June 14, 2007.

WDAI EAD. 2006. Equality State Almanac 2006. 10th Edition. [Web page] http://eadiv.state.wy.us/almanac/almanac.asp. Accessed on June 14, 2007.

Wyoming Department of Economic Development. 1986. Wyoming Profile.

Wyoming Department of Economic Development. 2002. Wyoming Data Book located at www.info.neded.org/databook/php, Accessed June 1, 2007.

Wyoming Department of Economic Development. 2006. Attendance at Selected Wyoming Attractions, 2001-2005. Tourism Division.

Wyoming Department of Education. 2007. Profile Reports for Cottonwood Elementary and Wright Junior/Senior High Schools. [Web Page] https://wdesecure.k12.wy.us/stats/wde_public.esc.district?school_year=2005-06&district_id=0301000&district_name=Campbell%20%231. Accessed on June 13, 2007.

Wyoming Department of Labor. 2007. Labor Market Information.

Wyoming Department of Transportation. 2005. 2004 Vehicle Miles Traveled. [web page] located at: http://www.dot.state.wy.us/

Wyoming Department of Property Assessment and Taxation. 2001. 2001 Annual Report. Located at www.pat.nol.org/reports/pdf/2001AR.PDF Accessed on 7/14/2004.

Wyoming Game and Parks Commission. 1982. Discover Wyoming Travel Guide, Wyomingland Magazine.

**Table 2.3-1 1980-2006 Historical and Current Population Change for Counties and Communities within the 80 km Radius of the Moore Ranch License Area**

| | Year | | | | | | Average Annual Percent Change | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| State/County/City | 1980 | 1990 | 2000 | 2002 | 2004 | 2006 | 1980/ 1990 | 1990/ 2000 | 2000/ 2002 | 2002/ 2004 | 2004/ 2006 |
| State of Wyoming | 469,557 | 453,588 | 493,782 | 498,973 | 505,534 | 515,004 | 4.1% | -0.3% | 0.9% | 0.5% | 0.7% |
| Campbell County | 24,367 | 29,370 | 33,698 | 36,142 | 36,629 | 38,934 | 8.8% | 2.1% | 1.5% | 3.6% | 0.7% |
| *Gillette city* | 12,134 | 17,635 | 19,646 | 21,819 | 22,174 | - | 6.9% | 4.5% | 1.1% | 5.5% | - |
| *Wright town* | - | 1,236 | 1,347 | 1,426 | 1,408 | - | - | - | 0.9% | 2.9% | - |
| Converse County | 14,069 | 11,128 | 12,052 | 12,352 | 12,501 | 12,866 | 13.7% | -2.1% | 0.8% | 1.2% | 0.6% |
| *Glenrock town* | 2,736 | 2,153 | 2,231 | 2,290 | 2,302 | - | 8.1% | -2.1% | 0.4% | 1.3% | - |
| *Rolling Hills town* | - | 330 | 449 | 460 | 461 | - | - | - | 3.6% | 1.2% | - |
| Johnson County | 6,700 | 6,145 | 7,075 | 7,412 | 7,609 | 8,014 | 2.0% | -0.8% | 1.5% | 2.4% | 1.3% |
| *Kaycee town* | 271 | 256 | 249 | 261 | 269 | - | 0.0% | -0.6% | -0.3% | 2.4% | - |
| Natrona County | 71,856 | 61,226 | 66,533 | 67,509 | 68,989 | 70,401 | 4.0% | -1.5% | 0.9% | 0.7% | 1.1% |
| *Bar Nunn town* | - | 835 | 936 | 955 | 1,139 | - | - | - | 1.2% | 1.0% | - |
| *Edgerton town* | 510 | 247 | 169 | 170 | 172 | - | 4.6% | -5.2% | -3.2% | 0.3% | - |
| *Midwest town* | 638 | 495 | 408 | 411 | 427 | - | - | -2.2% | -1.8% | 0.4% | - |
| Niobrara County | 2,924 | 2,499 | 2,407 | 2,266 | 2,283 | 2,253 | 0.0% | -1.5% | -0.4% | -2.9% | 0.4% |
| Weston County | 7,106 | 6,518 | 6,644 | 6,616 | 6,675 | 6,762 | 1.3% | -0.8% | 0.2% | -0.2% | 0.4% |

## Table 2.3-2 2005 Population by Age and Sex for Wyoming and the Counties within the 80 km Radius of the Moore Ranch License Area

| AREA | AGE | MALE | FEMALE | TOTAL | TOTAL % BREAKDOWN |
|---|---|---|---|---|---|
| State of Wyoming | Under 5 | 16,247 | 14,818 | 31,065 | 6.1% |
| | 5 - 19 | 51,074 | 48,270 | 99,344 | 19.5% |
| | 20 - 39 | 53,964 | 49,387 | 103,351 | 20.3% |
| | 40 - 64 | 107,479 | 106,018 | 213,497 | 41.9% |
| | 65+ | 27,962 | 34,075 | 62,037 | 12.2% |
| | Total | 256,726 | 252,568 | 509,294 | 100.0% |
| Campbell County | Under 5 | 1,399 | 1,184 | 2,583 | 6.9% |
| | 5 - 19 | 4,173 | 3,849 | 8,022 | 21.4% |
| | 20 - 39 | 4,307 | 4,006 | 8,313 | 22.2% |
| | 40 - 64 | 8,468 | 7,932 | 16,400 | 43.8% |
| | 65+ | 953 | 1,134 | 2,087 | 5.6% |
| | Total | 19,300 | 18,105 | 37,405 | 100.0% |
| Converse County | Under 5 | 340 | 323 | 663 | 5.2% |
| | 5 - 19 | 1,351 | 1,222 | 2,573 | 20.2% |
| | 20 - 39 | 1,072 | 1,157 | 2,229 | 17.5% |
| | 40 - 64 | 2,880 | 2,861 | 5,741 | 45.0% |
| | 65+ | 717 | 843 | 1,560 | 12.2% |
| | Total | 6,360 | 6,406 | 12,766 | 100.0% |
| Johnson County | Under 5 | 159 | 155 | 314 | 4.1% |
| | 5 - 19 | 699 | 675 | 1,374 | 17.8% |
| | 20 - 39 | 692 | 630 | 1,322 | 17.1% |
| | 40 - 64 | 1,634 | 1,729 | 3,363 | 43.6% |
| | 65+ | 622 | 726 | 1,348 | 17.5% |
| | Total | 3,806 | 3,915 | 7,721 | 100.0% |
| Natrona County | Under 5 | 2,350 | 2,208 | 4,558 | 6.5% |
| | 5 - 19 | 7,002 | 6,680 | 13,682 | 19.6% |
| | 20 - 39 | 7,115 | 6,992 | 14,107 | 20.2% |
| | 40 - 64 | 14,255 | 14,333 | 28,588 | 41.0% |
| | 65+ | 3,828 | 5,036 | 8,864 | 12.7% |
| | Total | 34,550 | 35,249 | 69,799 | 100.0% |
| Niobrara County | Under 5 | 44 | 49 | 93 | 4.1% |
| | 5 - 19 | 209 | 178 | 387 | 16.9% |
| | 20 - 39 | 145 | 189 | 334 | 14.6% |
| | 40 - 64 | 515 | 524 | 1,039 | 45.5% |
| | 65+ | 200 | 233 | 433 | 18.9% |
| | Total | 1,113 | 1,173 | 2,286 | 100.0% |
| Weston County | Under 5 | 156 | 155 | 311 | 4.7% |
| | 5 - 19 | 571 | 548 | 1,119 | 16.8% |
| | 20 - 39 | 638 | 549 | 1,187 | 17.8% |
| | 40 - 64 | 1,546 | 1,392 | 2,938 | 44.0% |
| | 65+ | 501 | 615 | 1,116 | 16.7% |
| | Total | 3,412 | 3,259 | 6,671 | 100.0% |

Source: U.S. Bureau of the Census 2007

## Table 2.3-3 2005-2025 Population Projections for Wyoming and the Counties within the 80 km Radius of the Moore Ranch License Area

| Area | Census 2000 | Projected 2005 | Projected 2010 | Projected 2015 | Projected 2020 |
|---|---|---|---|---|---|
| State of Wyoming | 494,078 | 506,184 | 519,595 | 529,352 | 533,534 |
| Campbell County | 33,981 | 37,075 | 39,701 | 42,414 | 44,595 |
| Converse County | 12,104 | 12,433 | 12,882 | 13,226 | 13,392 |
| Johnson County | 7,108 | 7,725 | 8,268 | 8,789 | 9,198 |
| Natrona County | 66,550 | 68,965 | 70,529 | 71,685 | 72,151 |
| Niobrara County | 2,390 | 2,185 | 2,102 | 1,996 | 1,892 |
| Weston County | 6,642 | 6,645 | 6,669 | 6,627 | 6,509 |

Note: Population projections for the years after 2020 are not available.
Source: Wyoming Department of Administration and Information, Economic Analysis Division 2007.

**Table 2.3-4 2000 Population within the 80 km Radius of the Moore Ranch License Area**

| | Radius in km | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 33 | 88 | 112 | 137 | 161 | 3,682 | 4,221 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 5 | 88 | 112 | 147 | 205 | 1,901 | 2,469 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 1,408 | 109 | 116 | 624 | 679 | 2,942 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 503 | 113 | 132 | 224 | 3,139 | 4,114 |
| E | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 1,007 | 113 | 587 | 435 | 1,207 | 3,354 |
| ESE | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 69 | 91 | 117 | 131 | 107 | 518 |
| SE | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 5 | 68 | 146 | 263 | 303 | 153 | 944 |
| SSE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 125 | 242 | 273 | 194 | 1,701 | 2,535 |
| S | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 136 | 190 | 188 | 164 | 2,763 | 3,451 |
| SSW | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 30 | 38 | 67 | 115 | 133 | 386 |
| SW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 38 | 46 | 177 | 341 | 631 |
| WSW | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 599 | 38 | 53 | 83 | 98 | 876 |
| W | 0 | 0 | 0 | 0 | 0 | 9 | 8 | 3 | 29 | 0 | 33 | 39 | 49 | 170 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 29 | 38 | 38 | 269 | 37 | 414 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 71 | 110 | 113 | 78 | 402 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 112 | 136 | 148 | 164 | 560 |
| Total | 0 | 0 | 0 | 0 | 0 | 19 | 47 | 60 | 4,238 | 1,563 | 2,443 | 3,385 | 16,232 | 27,987 |

Notes: Current population living between 10 and 80 km of the mine site were estimated using 2004 census block data. Field reconnaissance was conducted in 2007 to verify data collected within 2 miles (3.22 km). The population between 3 and 30 km was estimated with the average household size in 2000 and aerial photos to count the number of housing units in each sector. See Section 2.3.1. for a detailed description of the methodology.

**Table 2.3-5 2005 Annual Average Labor Force Characteristics and Employment in Economic Sectors for State of Wyoming for Campbell and Natrona Counties**

| | State of Wyoming | | Campbell County | | Natrona County | |
|---|---|---|---|---|---|---|
| Labor Force | 284,538 | - | 23,679 | - | 40,164 | - |
| Employment | 274,362 | - | 23,062 | - | 38,797 | - |
| Unemployment | 10,176 | - | 617 | - | 1,367 | - |
| **Unemployment Rate** | **3.6** | **-** | **2.6** | **-** | **3.4** | **-** |
| Total employment | 360,558 | 100.0% | 27,714 | 100.0% | 50,149 | 100.0% |
| Farm employment | 12,096 | 3.4% | 611 | 2.2% | 433 | 0.9% |
| Non-farm employment | 348,462 | 96.6% | 27,103 | 97.8% | 49,716 | 99.1% |
| Forestry, fishing, related activities, and other 3/ | 2,780 | 0.8% | (D) | - | (D) | - |
| Mining | 25,578 | 7.1% | 7,340 | 26.5% | 4,656 | 9.3% |
| Utilities | 2,422 | 0.7% | 190 | 0.7% | (D) | |
| Construction | 29,356 | 8.1% | 2,735 | 9.9% | 3,533 | 7.0% |
| Manufacturing | 11,352 | 3.1% | 632 | 2.3% | 1,979 | 3.9% |
| Wholesale trade | 8,784 | 2.4% | 1,281 | 4.6% | 2,700 | 5.4% |
| Retail trade | 40,188 | 11.1% | 2,442 | 8.8% | 6,307 | 12.6% |
| Transportation and warehousing | 12,842 | 3.6% | 1,209 | 4.4% | (D) | - |
| Information | 5,088 | 1.4% | 228 | 0.8% | 676 | 1.3% |
| Finance and insurance | 11,247 | 3.1% | 453 | 1.6% | 1,794 | 3.6% |
| Real estate and rental and leasing | 13,837 | 3.8% | 441 | 1.6% | 2,267 | 4.5% |
| Professional and technical services | 16,000 | 4.4% | 939 | 3.4% | 2,383 | 4.8% |
| Management of companies and enterprises | 970 | 0.3% | 179 | 0.6% | 96 | 0.2% |
| Administrative and waste services | 11,871 | 3.3% | 853 | 3.1% | 2,343 | 4.7% |
| Educational services | 2,985 | 0.8% | 60 | 0.2% | 373 | 0.7% |
| Health care and social assistance | 26,555 | 7.4% | 978 | 3.5% | 5,688 | 11.3% |
| Arts, entertainment, and recreation | 6,612 | 1.8% | 169 | 0.6% | 919 | 1.8% |
| Accommodation and food services | 31,964 | 8.9% | 1,748 | 6.3% | 3,480 | 6.9% |
| Other services, except public administration | 19,524 | 5.4% | (D) | - | 3,013 | 6.0% |
| Government and government enterprises | 68,507 | 19.0% | 3,911 | 14.1% | 5,797 | 11.6% |
| Federal, civilian | 7,491 | 2.1% | 86 | 0.3% | 695 | 1.4% |
| Military | 6,138 | 1.7% | 213 | 0.8% | 396 | 0.8% |
| State and local | 54,878 | 15.2% | 3,612 | 13.0% | 4,706 | 9.4% |
| State government | 14,942 | 4.1% | 170 | 0.6% | 736 | 1.5% |
| Local government | 39,936 | 11.1% | 3,442 | 12.4% | 3,970 | 7.9% |

(D) = Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
- = Not Available

**Table 2.3-6 2006 Housing Characteristics for Campbell and Natrona Counties**

| | Campbell County | Natrona County |
|---|---|---|
| Type of Unit | Number of Units | Number of Units |
| Housing Unit Estimate[1] | 14,085 | 30,668 |
| Rental Housing Costs[2] | | |
| Apartments | $649 | $508 |
| House | $867 | $767 |
| Mobile Home | $786 | $581 |
| Rental Vacancy[3] | | |
| Total Units | 1,467 | 3,226 |
| Vacant Units | 6 | 54 |
| Vacancy Rate | 0.4% | 1.67% |

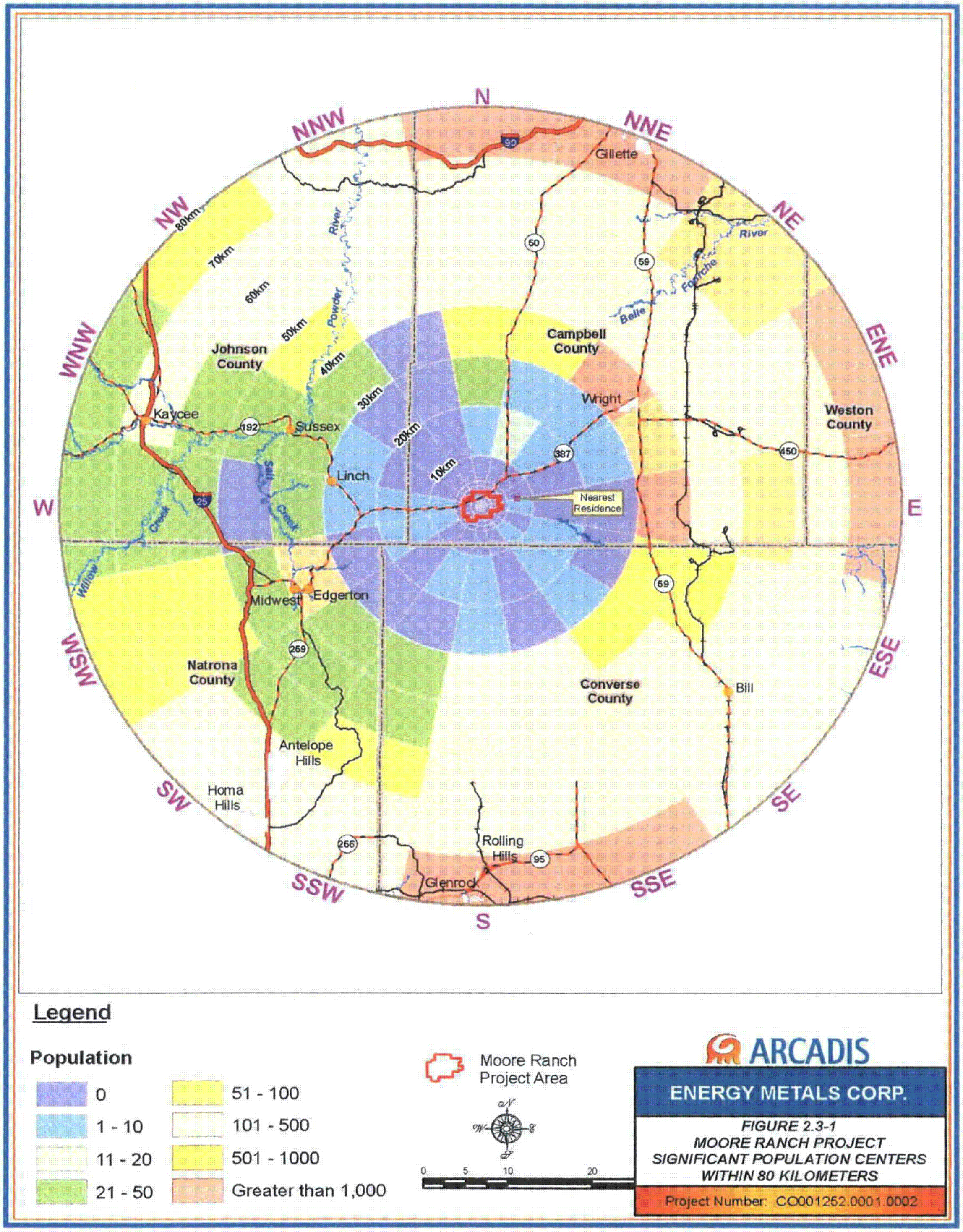
1 – Intercensal estimate for July 2005
2 – Second quarter 2006
3 – Rental vacancy survey conducted in December 2006
Source: Wyoming Community Development Authority 2007

**Table 2.3-7 Race and Poverty Level Characteristics of the Population in the Moore Ranch License Area Census Tracts**

| | State of Wyoming | Percent of Total State Population | Census Tract 1, Campbell County | Percent of Census Tract 1 | Census Tract 9566, Converse County | Percent of Census Tract 9566 | Block Group 1, Census Tract 9566, Converse County | Percent of Block Group 1, Census Tract 9566 | Census Tract 9551, Johnson County | Percent of Census Tract 9551 | Census Tract 14.01, Natrona County | Percent of Census Tract 14.01 | Census Tract 18, Natrona County | Percent of Census Tract 18 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 493,782 | 100.0 | 4,779 | 100.0 | 2,944 | 100.0 | 1,412 | 100.0 | 1,918 | 100.0 | 3,478 | 100.0 | 3,285 | 100.0 | **17,816** |
| Urban: | 322,073 | 65.2 | 418 | 8.7 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 9 | 0.3 | **427** |
| Inside urbanized areas | 125,706 | 25.5 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 9 | 0.3 | **9** |
| Inside urban clusters | 196,367 | 39.8 | 418 | 8.7 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | **418** |
| Rural | 171,709 | 34.8 | 5,615 | 117.5 | 2,944 | 100.0 | 1,412 | 100.0 | 1,918 | 100.0 | 3,478 | 100.0 | 3,276 | 99.7 | **18,643** |
| White alone | 454,095 | 92.0 | 4,671 | 97.7 | 2,805 | 95.3 | 1,331 | 94.3 | 1,877 | 97.9 | 3,284 | 94.4 | 3,150 | 95.9 | **17,118** |
| Black or African American alone | 3,126 | 0.6 | 1 | 0.0 | 6 | 0.2 | 3 | 0.2 | 1 | 0.1 | 11 | 0.3 | 8 | 0.2 | **30** |
| American Indian and Alaska Native alone | 11,363 | 2.3 | 22 | 0.5 | 18 | 0.6 | 13 | 0.9 | 8 | 0.4 | 41 | 1.2 | 45 | 1.4 | **147** |
| Asian alone | 2,972 | 0.6 | 4 | 0.1 | 12 | 0.4 | 5 | 0.4 | 3 | 0.2 | 8 | 0.2 | 6 | 0.2 | **38** |
| Native Hawaiian and Other Pacific Islander alone | 232 | 0.0 | 2 | 0.0 | 1 | 0.0 | 1 | 0.1 | 0 | 0.0 | 8 | 0.2 | 2 | 0.1 | **14** |
| Some other race alone | 12,595 | 2.6 | 24 | 0.5 | 60 | 2.0 | 46 | 3.3 | 11 | 0.6 | 47 | 1.4 | 28 | 0.9 | **216** |
| Two or more races | 9,399 | 1.9 | 55 | 1.2 | 42 | 1.4 | 13 | 0.9 | 18 | 0.9 | 79 | 2.3 | 46 | 1.4 | **253** |
| People who are Hispanic or Latino | 31,384 | 6.4 | 88 | 1.8 | 113 | 3.8 | 73 | 5.2 | 52 | 2.7 | 106 | 3.0 | 78 | 2.4 | **510** |
| Median household income in 1999 | 37,892 | - | 55,233 | - | 47,250 | - | 44,821 | - | 40,053 | - | 38,629 | - | 45,481 | - | na |
| Per capita income in 1999 | 19,134 | - | 21,886 | - | 22,673 | - | 19,598 | - | 20,595 | - | 15,601 | - | 21,084 | - | na |
| Population with income in 1999 below poverty level: | 54,777 | - | 398 | - | 157 | - | 85 | - | 241 | - | 571 | - | 191 | - | **1,643** |
| Percent below poverty level | 11.1% | - | 8.3% | - | 5.3% | - | 6.0% | - | 12.6% | - | 16.4% | - | 5.8% | - | **9.2%** |

Source: U.S. Bureau of Census 2000

**Figure 2.3-1 Significant Population Centers within an 80 km Radius (50 miles) of the Moore Ranch License Area**



2.4.2.1 Visual Resource Management Classes

The elements used to determine the visual resource inventory class are the scenic quality, sensitivity levels, and distance zones. Each of the elements used to identify the VRM Class is defined below:

**Scenic Quality** - Scenic quality is a measure of the visual appeal of a tract of land. In the visual resource inventory process, public lands are assigned an A, B, or C rating based on the apparent scenic quality, which is determined using seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. During the rating process, each of these factors is ranked comparatively against similar features within the physiographic province.

**Sensitivity Level** – A degree or measure of viewer interest in the scenic qualities of the landscape. Factors to consider include 1) type of users; 2) amount of use; 3) public interest; 4) adjacent land uses; and 5) special areas. Three levels of sensitivity have been defined:

- Sensitivity Level 1 – The highest sensitivity level, referring to areas seen from travel routes and use areas with moderate to high use.

- Sensitivity Level 2 – An average sensitivity level, referring to areas seen from travel routes and use areas with low to moderate use.

- Sensitivity Level 3 – The lowest sensitivity level, referring to areas seen from travel routes and use areas with low use.

**Distance Zones** – Areas of landscapes denoted by specified distances from the observer, particularly on roads, trails, concentrated-use areas, rivers, etc. The three categories are foreground-middleground, background, and seldom seen.

- Foreground-Middleground – The area visible from a travel route, use area, or other observer position to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape and vegetation is apparent only in pattern or outline.

- Background - The viewing area of a distance zone that lies beyond the foreground and middleground. This area usually measures from a minimum of 3 to 5 miles to a maximum of about 15 miles from a travel route, use area, or other observer position. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

- Seldom Seen – The area is screened from view by landforms, buildings, other landscape elements, or distance.

The visual resource inventory classes are used to develop visual resource management classes, which are generally assigned by the BLM through the resource management plan process[2]. VRM objectives are developed to protect scenic public lands, especially those lands that receive the greatest amount of public viewing. The following VRM classes are objectives that outline the amount of disturbance an area can tolerate before it no longer meets the visual quality of that class.

- Class I Objective: To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.
- Class II Objective: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.
- Class III Objective: To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.
- Class IV Objective: To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

The Scenic Quality, Sensitivity Level, and Distance Zone inventory levels are combined to assign the VRM Class to inventoried lands as shown in the following matrix:

| Determining BLM Visual Resource Inventory Classes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Visual Sensitivity | | High | | | Medium | | | Low |
| Special Areas | | I | I | I | I | I | I | I |
| Scenic Quality | A | II | II | II | II | II | II | II |
| | B | II | III | III/IV | III | IV | IV | IV |
| | C | III | IV | IV | IV | IV | IV | IV |
| Distance Zones | | f/m | b | ss | f/m | b | ss | ss |

f/m = foreground-middleground
b = background
ss – seldom seen

2.4.2.2 Moore Ranch Visual Resource Management Rating

The BLM has inventoried the landscape within the Moore Ranch License Area and the surrounding 2-mile area and rated the areas as VRM Class IV. The management objective of VRM Class IV is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

The scenic quality inventory was based on methods provided in BLM Manual 8410 – Visual Resource Inventory[3] as well as a review of the factors that contribute to the existing VRM Class IV inventory for the License Area. The key factors of landform, vegetation, water, color, influence of adjacent scenery, scarcity and cultural modifications were evaluated and scored according to the rating criteria. The criteria for each key factor ranged from high to moderate to low quality based on the variety of line, form, color, texture and scale of the factor within the landscape. A score was associated with each rating criteria, with a higher score applied to greater complexity and variety for each factor in the landscape. The results of the inventory and the associated score for each key factor are summarized in Table 2.4-1. According to NUREG-1569[4], if the visual resource evaluation rating is 19 or less, no further evaluation is required. Based on field reconnaissance conducted in May 2007, the total score of the scenic quality inventory for the Moore Ranch License Area is 4; therefore, no further evaluation of existing scenic resources and any changes to scenic resources from proposed project facilities is required.

**Table 2.4-1 Scenic Quality Inventory and Evaluation for the Moore Ranch License Area**

| Key Factor | Rating Criteria | Score |
|---|---|---|
| Landform | Flat to rolling terrain with no interesting landscape features | 1 |
| Vegetation | Very little variety in vegetation, which consists of grazed grassland with sage and other shrubs. | 1 |
| Water | Water is present, but not evident as viewed from residences and roads | 0 |
| Color | Vegetation and soil colors are tan (various midtones) throughout most of the year. | 1 |
| Influence of adjacent scenery | Adjacent scenery is very similar to License Area, and provides no variety in line, form, color, and texture. | 0 |
| Scarcity | Landscape is common for the region | 1 |
| Cultural modifications | Existing modifications consist of numerous oil and gas production facilities and infrastructure, and grazing activities. | 0 |
| | **Total Score** | **4** |

### 2.4.3 References

[1] Brunette, James. 2007. *Class III Cultural Resource Inventory for the Energy Metals Corporation, Moore Ranch In-Situ Uranium Project.* Frontier Archaeology. September 17, 2007

[2] United States Department of the Interior (USDOI), Bureau of Land Management (BLM). Buffalo Resource Management Plan. [Web Page] http://www.blm.gov/rmp/WY/application/rmp_toc.cfm?rmpid=101. Accessed June 8, 2007.

[3] United States Department of the Interior (USDOI), Bureau of Land Management (BLM). 1986. Visual Resource Inventory. BLM Manual Handbook 8410-1. 1986.

[4] U.S. Nuclear Regulatory Commission, NUREG-1569, *Standard Review Plan for In situ Leach Uranium Extraction License Applications."* 2003.

## 2.5 METEOROLOGY

### 2.5.1 Introduction

The proposed Moore Ranch Project is located in a semi-arid or steppe climate. The region is characterized seasonally by cold harsh winters, hot dry summers, relatively warm moist springs and cool autumns. Temperature extremes range from roughly -25° F in the winter to 100° F in the summer. The "last freeze" occurs during late May and the "first freeze" mid-to-late September.

Yearly precipitation totals are typically near 10 inches. The region is prone to severe thunderstorm events throughout the spring and early summer months and much of the precipitation is attributed to these events. In a typical year, the area will see 4 or 5 severe thunderstorm events (as defined by the National Weather Service criteria) and 40 to 50 thunderstorm days. Autumn stratiform rain events also contribute to precipitation totals, but to a lesser degree than those before mentioned. Snow frequents the region throughout winter months (40-50 in / year), but provides much less moisture than rain events.

Windy conditions are fairly common to the area. Nearly 5% of the time hourly wind speed averages exceed 25 mph. The predominant wind direction is west/southwest with the wind blowing out of that direction 20% of the time. A north/northwest secondary mode is also present. Surface wind speeds are relatively high all year-round, with hourly averages 11 - 15 mph. Higher average wind speeds are encountered during the winter months while summer months experience lower average wind speeds.

Meteorological data has been compiled for ten sites surrounding the Moore Ranch project. Data has been acquired through the Western Regional Climate Center (WRCC, 2007) for eight COOP and ASOS stations operated by the National Weather Service (NWS) including Casper AP, Douglas, Dull Center 1SE, Glenrock 5 ESE, Kaycee, Lance Creek 3 WNW, Midwest, and Reno. In addition, Glenrock Coal Company (GCC) and Antelope Coal Company (ACC) meteorological data have been obtained through Inter-Mountain Laboratories (IML) located in Sheridan Wyoming. The latter two mentioned sites are operated in compliance with regulations set forth by the Wyoming Air Quality Division (AQD) for air quality monitoring. IML has maintained the sites and archived the data for nearly 20 years. Baseline meteorological information for the Moore Ranch Project was collected by IML and subsequently reported to EMC and is described in this Section. Table 2.5-1 provides the station identification, coordinates, and period of operation for each site.

The Antelope Coal (ACC) and Glenrock Coal (GCC) mines were both analyzed in the site specific analysis due to their proximity to the permitted region and to provide perspective from both a ridge top and drainage. The GCC site is located on the western slope just below the peak of a ridge and ACC is situated on the eastern slope of a small drainage. ACC data is chosen over GCC as most representative of the proposed project area, for several reasons. The ACC site, like the proposed project area, extends from the eastern slope of a ridge downward into a drainage. GCC lies slightly higher in elevation and is on the opposite facing slope. GCC's location leads to slightly higher wind speeds since ACC is slightly sheltered from the predominant winds. ACC experiences greater temperature extremes than GCC, which may also be related to terrain. Lastly, ACC is approximately 10 miles closer to the project area than GCC.

**Table 2.5-1 Meteorological Stations Included in Climate Analysis.**

| Name | Agency | X | Y | Z(ft) | Years_Operation |
|---|---|---|---|---|---|
| Antelope Coal Company | IML | 474179 | 4816180 | 4675 | 1986-2006 |
| Glenrock Coal Company | IML | 431649 | 4767610 | 4910 | 1996-2006 |
| Casper AP (112) | NWS | 380229 | 4750539 | 5338 | 1948-2005 |
| Douglas (118) | NWS | 468655 | 4732910 | 4820 | 1909-2005 |
| Dull Center 1SE (71) | NWS | 503239 | 4806131 | 4420 | 1926-2005 |
| Glenrock 5 ESE (117) | NWS | 436247 | 4742017 | 4950 | 1941-2005 |
| Kaycee (58) | NWS | 368677 | 4840739 | 4660 | 1900-2005 |
| Lance Creek 3 WNW (77) | NWS | 528436 | 4782869 | 4340 | 1962-1984 |
| Midwest (59) | NWS | 396362 | 4806926 | 4820 | 1939-2005 |
| Reno (68) | NWS | 458891 | 4836243 | 5080 | 1963-1983 |

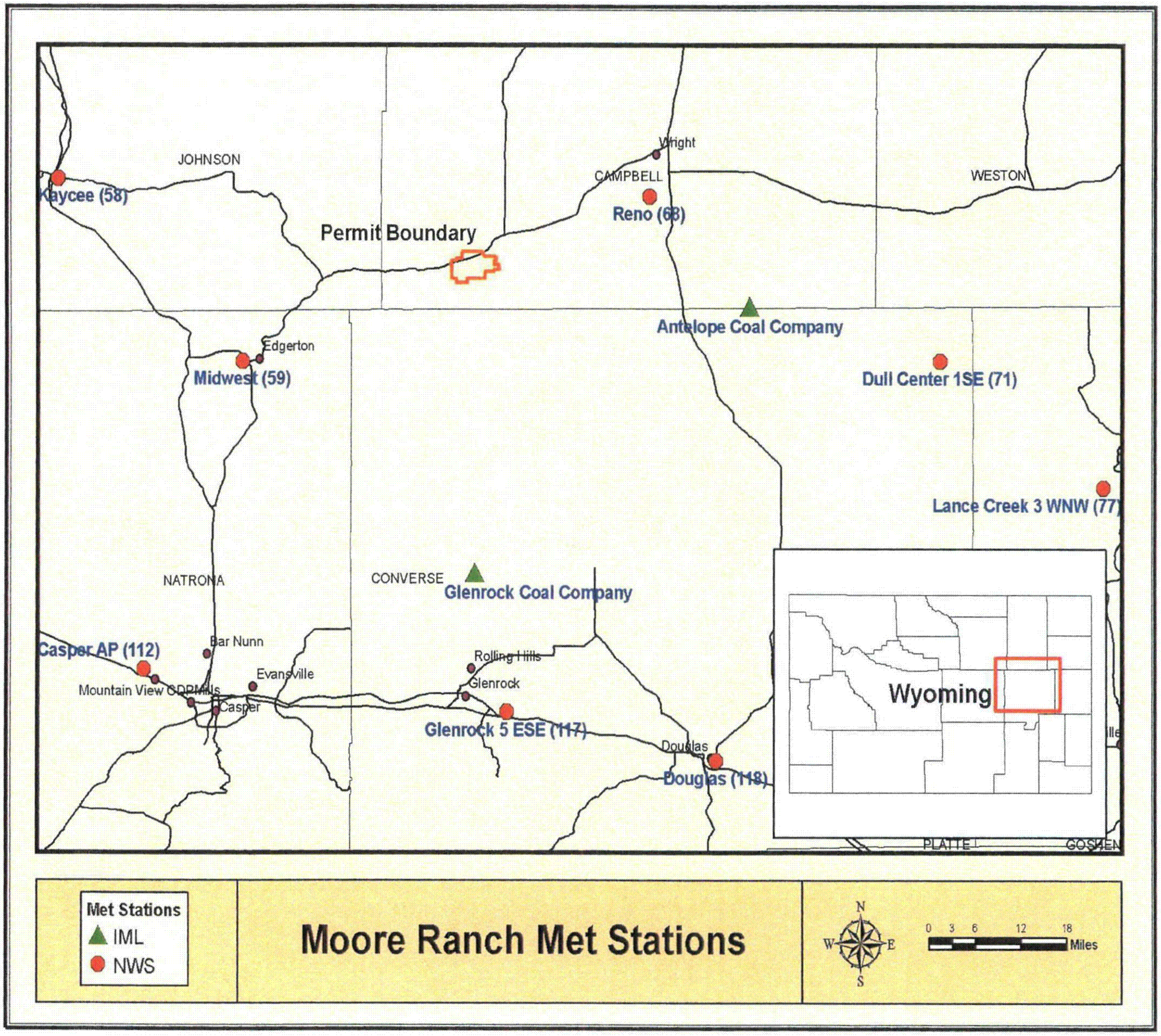
The ten sites collectively have been analyzed to provide a regional climatic temperature and precipitation analysis of the proposed project area. Only the Casper AP, GCC, and ACC sites will be analyzed for the regional wind summaries. The eight NWS sites will be incorporated into the snowfall discussion as neither mine site records snowfall data. No on-site data is available for the proposed area and the combination of the ACC and GCC sites will be substituted as the nearest representative available data sets for the site specific analysis. GCC and ACC lie in similar terrain as that seen in the proposed project area. Figure 2.5-1 shows the ten sites in relation to the project permit boundary. As can be seen in the figure, ACC and GCC are the closest available sites with wind data. The closest NWS operated station which continuously records all weather parameters is the Casper AP site which lies some 55-60 miles to the southwest.

A regional overview will be presented first. The section will include a discussion of the maximum and minimum temperature, relative humidity, annual precipitation including snowfall estimates, and a short wind speed and direction summary. ACC, GCC and the Casper AP provide the only wind data for the region. Casper AP will be incorporated into the regional overview and ACC and GCC will be analyzed for the site specific analysis. The last portion of the regional analysis will include a general climate data summary from Casper.

The site specific analysis will follow with much of the data based on the ACC, and GCC meteorological data with many of the same parameters listed previously. An in-depth wind analysis will be comprised of summaries including wind speed and direction averages, joint frequency distributions to characterize the wind data for the site by stability class, and wind speed distributions to provide insight into the wind speed relative frequencies. A seasonal data discussion is included for the temperature and wind parameters. The seasonal classification does not follow the general calendar dates. The seasons are classified in three month intervals as follows; January – March for winter, April-June for spring, July – September for summer, and October – December for fall. No site specific general climate data will be included as the regional evaluation is deemed adequate.

The ACC and GCC meteorological stations were also proposed to the NRC for use in baseline data collection for the Allemand-Ross Project by High Plains Uranium, Inc. (HPU) in August of 2006. Since that time, HPU was acquired by Energy Metals Corporation. In a letter from the NRC to HPU dated September 14, 2006, the NRC states that the meteorological stations at the Antelope and Glenrock mines meet the standards identified in NRC Regulatory Guide 3.63, *Onsite Meteorological Measurement Program for Uranium Recovery Programs- Data Acquisition and Reporting,* and can be recognized as "standard installations" per NUREG-1569. Therefore, data from these stations may be used in place of NWS Station Data. As described above, the ACC and GCC stations are closer to the Moore Ranch Project than the nearest NWS station and lie in very similar terrain. As a result, EMC believes that data from the ACC and GCC stations is representative of expected long term conditions at the Moore Ranch site.

**Figure 2.5-1 NWS and Coal Mine Meteorological Stations.**



## 2.5.2 Regional Overview

### 2.5.2.1 Temperature

The annual average temperature for the region is 46° F. The graph (Figure 2.5-2) shows monthly average temperatures for the two mine sites and the Casper AP. As illustrated, there is very little difference exhibited between the three sites. July shows the highest average monthly temperatures followed by August. January and December record the lowest average temperatures for the year. Table 2.5-2 below compares the monthly average temperatures for the three sites. The slight differences in average temperatures could be attributed to the small change in elevation between the stations. ACC has the highest average temperature of the three and the lowest elevation while Casper has the lowest average temperature and is the highest in elevation.

The proposed project region has annual average maximum temperatures of 58.5° F and average minimum temperatures of 32.5° F. July has the highest maximum temperatures with averages near 90° F while the lowest minimum temperatures are observed in January with averages near 10° F. Annual average minimum and maximum temperatures are shown in Figures 2.5-3 and 2.5-4, respectively.

Large diurnal temperature variations are found in the region due in large part to its altitude and low humidity. Figure 2.5-5 depicts the seasonal diurnal temperature variations for the two mine sites. The site specific monthly values are shown in Table 2.5-2 spring and summer daily variations of 15° - 25° F are common with maximum temperature variations of 30 - 40° F observed during extremely dry periods. Less daily variation is observed during the cooler portions of the year as fall and winter have variations of 10° - 15° F.

The lesser variation in daily temperature can be attributed to the more stable environment the region is exposed to during the fall and winter months. Stable periods have much lower mixing heights and accompanying lapse rates allowing for less temperature variation. The graphs also show ACC having larger diurnal variations than GCC. This may be attributed to the major soil type/surface each site is exposed too. ACC is an active coal mine with much bare soil (coal) exposed and little vegetation in the areas surrounding the meteorological station. GCC, on the other hand, has been in reclaim for an extended period with the meteorological station located in the middle of rolling prairie with native grasses and scattered scrub brush present. The vegetated region will "hold" more moisture and moderate temperatures to a greater extent as more energy is applied to latent heating rather than to sensible heating.

**Table 2.5-2 Annual and Monthly Average Temperatures for ACC, GCC, and Casper AP**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Ann |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Casper | 23.4 | 27.1 | 33.6 | 42.8 | 52.7 | 62.9 | 70.9 | 69.2 | 58.5 | 46.6 | 33.2 | 25.3 | 45.5 |
| Glenrock | 26.1 | 26.7 | 32.5 | 41.7 | 51.1 | 60.7 | 70.8 | 68.1 | 57.9 | 45.7 | 33.7 | 26.1 | 46.1 |
| Antelope | 26.0 | 27.2 | 34.4 | 43.7 | 53.4 | 63.9 | 71.5 | 69.9 | 58.7 | 45.4 | 33.5 | 26.1 | 47.8 |

**Figure 2.5-2 Average Monthly Temperatures for ACC, GCC, and Casper AP**

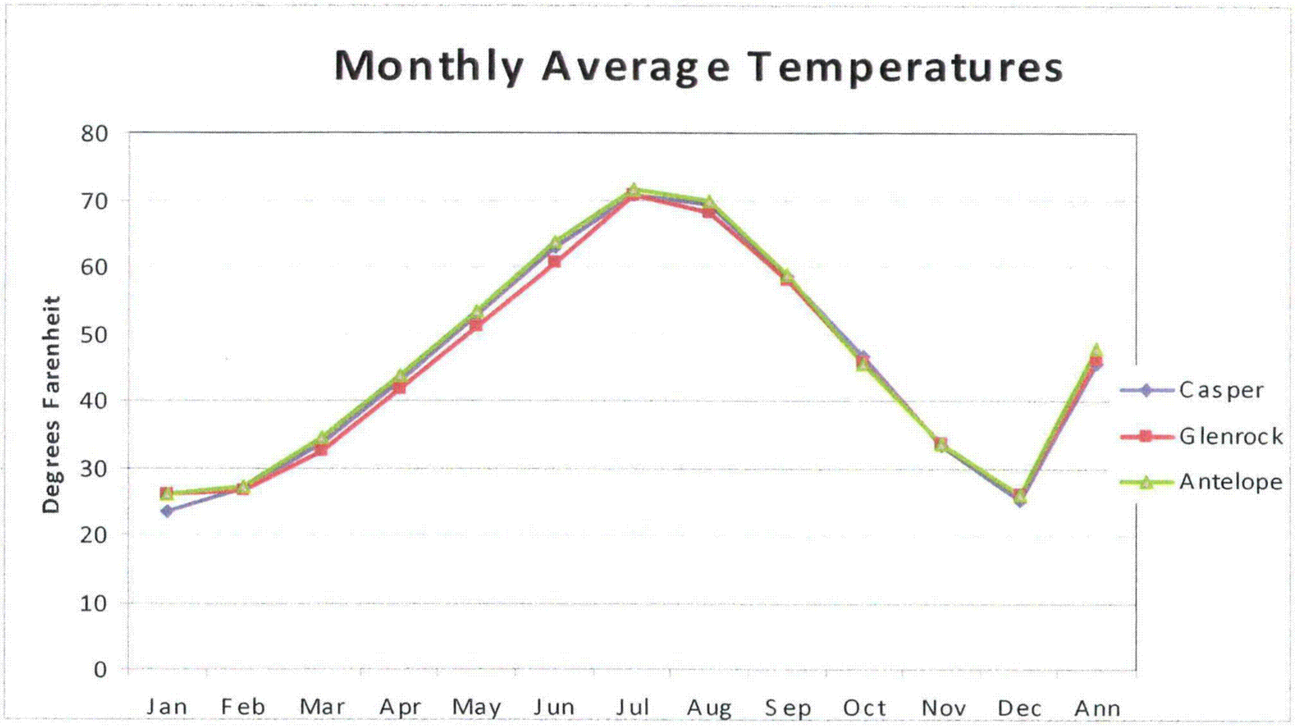


**Figure 2.5-3 Regional Annual Average Minimum Temperatures.**

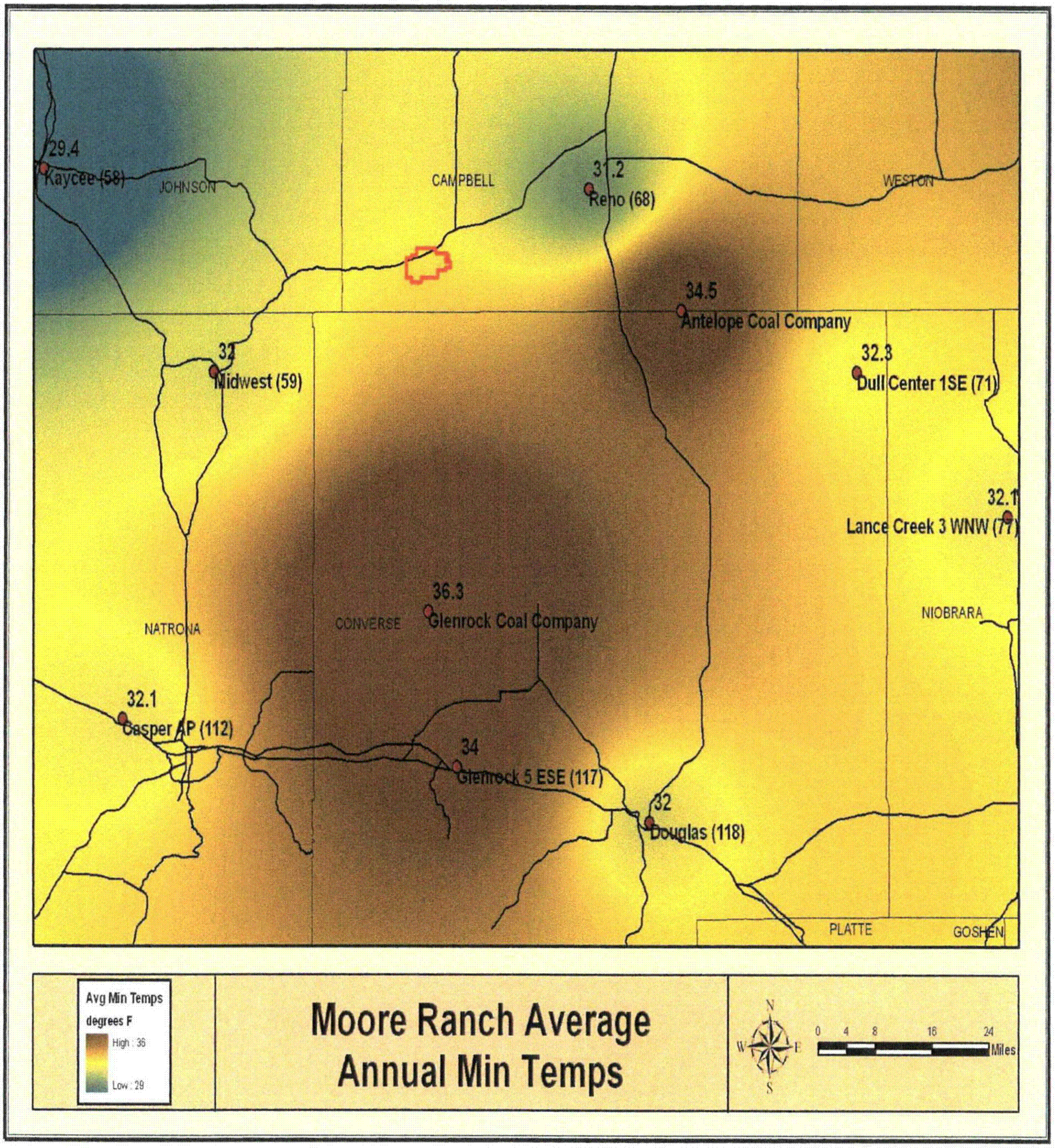


**Figure 2.5-4 Regional Annual Average Maximum Temperatures.**

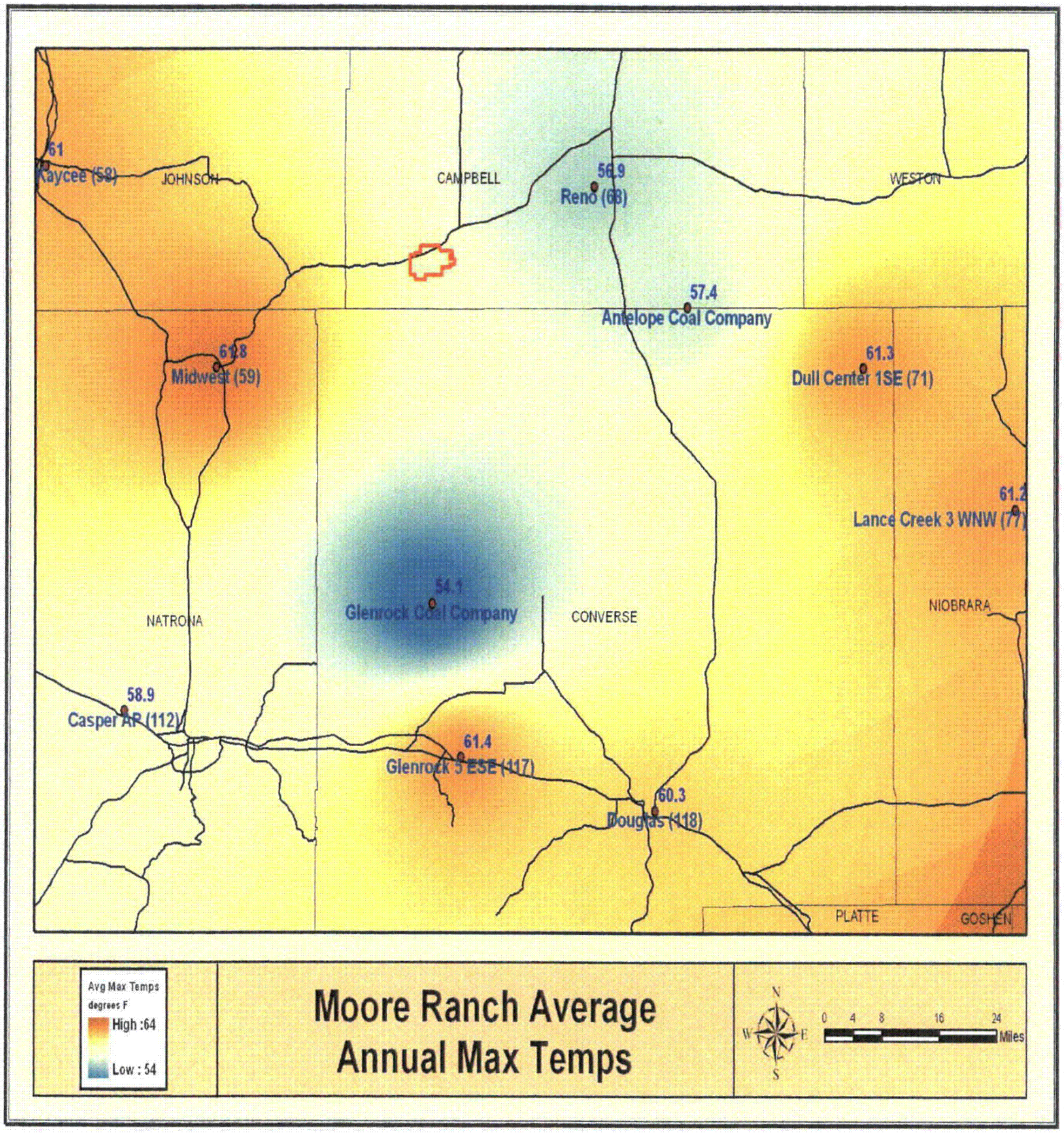
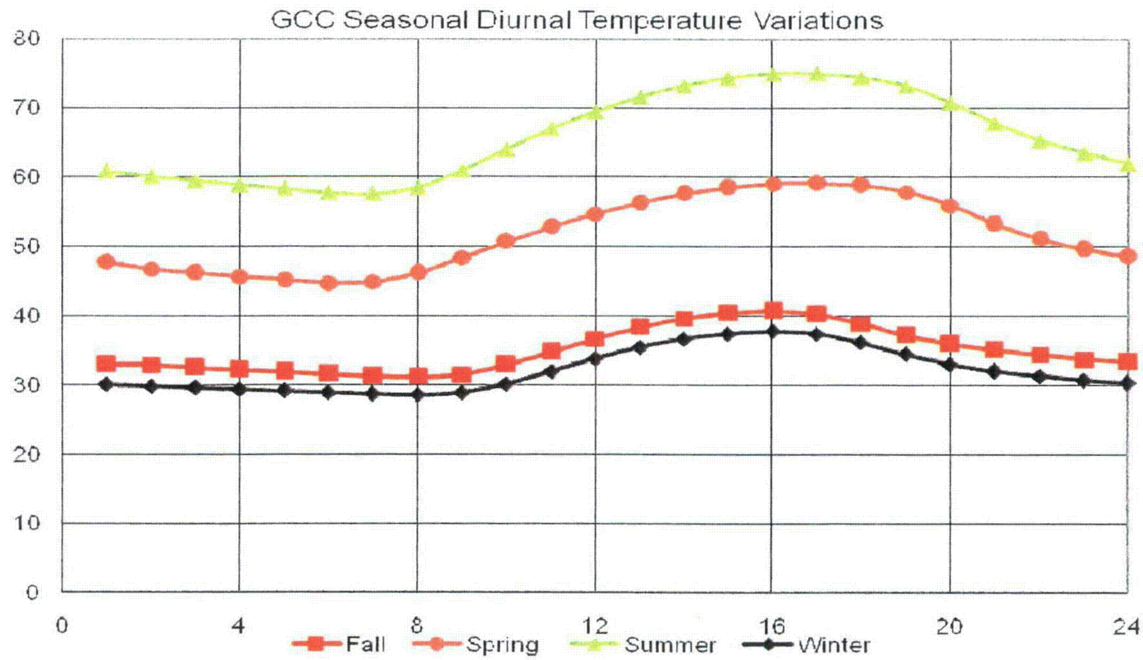
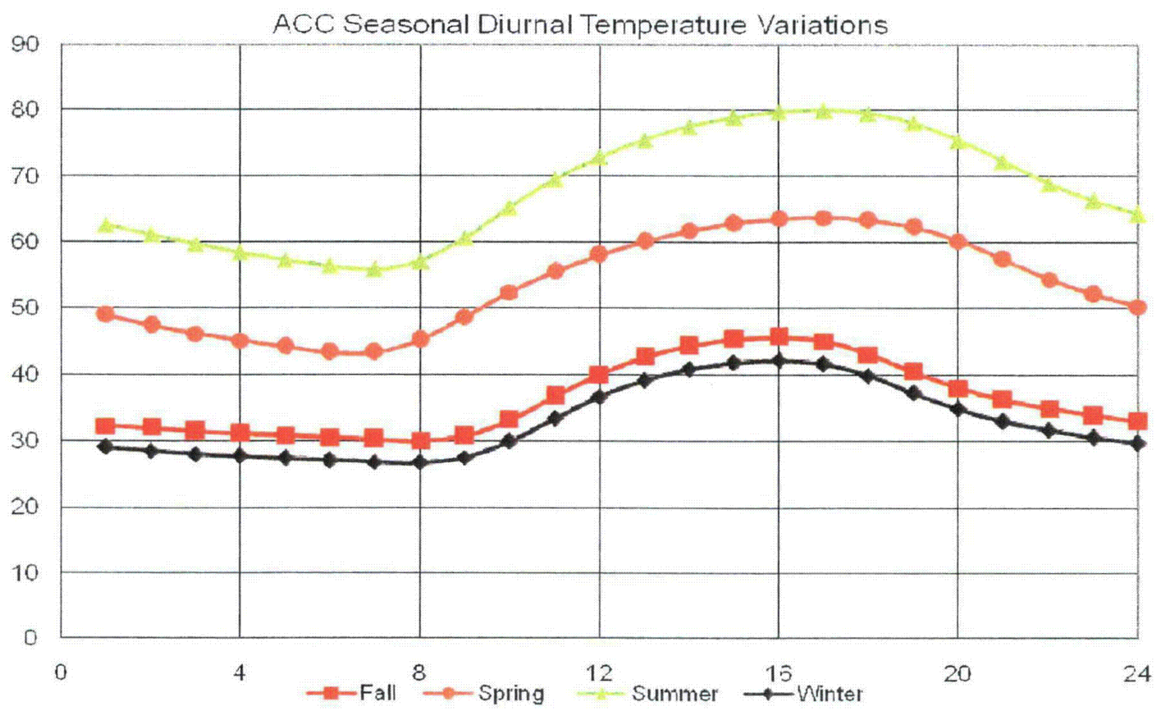


**Figure 2.5-5 GCC (top) and ACC (bottom) Seasonal Diurnal Temperature Variations**

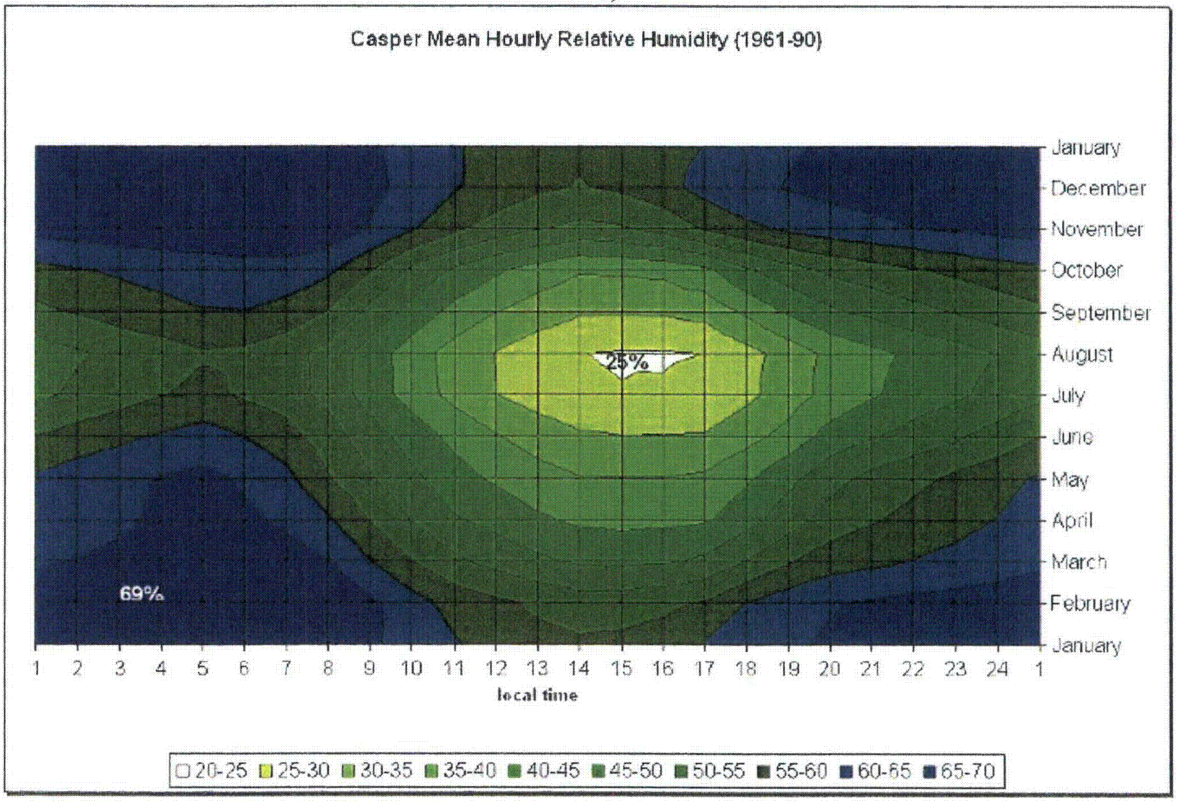


### 2.5.2.2 Relative Humidity

The Casper AP is the only site included in the analysis that records relative humidity (dew point) data. The graph shown in Figure 2.5-6 presents data taken from the Wyoming Climate Atlas (WRDS, 2007). The graph shows the mean hourly relative humidity (%) by time of day and month. It can be seen here that July is the "driest" month of the year followed by August and June. It also shows the winter months of December and January are the "wettest" portions of the year. The extreme values are stenciled on the graph where 25% is the lowest mean hourly value while 69% is the highest mean hourly value.

**Figure 2.5-6 Mean Monthly and Hourly Relative Humidity for Casper AP (WRDS, 2007)**




Relative humidity maximums occur more frequently in mornings (5:00 am) while minimums typically occur during the afternoon (5:00 pm). The average annual readings are 70% and 43% for mornings and afternoons, respectively. Mean monthly afternoon values range from 24% in August to 62% in December while morning mean values range from 66% in August to 77% in May. There is a much greater variation in the afternoon values which coincides with the greater temperature variations which occur during that time. Relative humidity is a temperature based calculation which shows the fraction of moisture present versus the amount of moisture for saturated air at that temperature.

2.5.2.3 Precipitation

The region is characterized by extremely dry conditions. On average, the region experiences only 40-60 days with measurable (>0.01 in) precipitation (WRCC, 2007). The proposed project region has an annual average in the 11 – 11.5 inch category based on the interpolated values (Figure 2.5-7). Annual averages across the region range from 9 – 13 inches. Spring and early summer (May-July) thunderstorms produce the majority of the precipitation, 45%. May is typically the wettest month of the year; all stations have monthly averages greater than 2 inches for that time as can be seen in Figure 2.5-8 below. January, on the contrary, is the driest month of the year as values are generally one half inch or less. The winter months (Dec-Feb) typically account for only 10% of the yearly totals. A secondary minimum is also evident during August as warm conditions have persisted over the course of the summer months. This promotes extremely stable conditions and light precipitation amounts as convective activity is limited.

Severe weather does arise throughout the region, but is limited to 4-5 severe events per year. These severe events are generally split between hail and damaging wind events. Tornadoes can occur but on rare occasions, with less than one tornado per county per year (Martner, 1986).

Major snowstorms (more than 6 in/day) also frequent the region. The region surrounding Casper experiences one to two snowstorms per year. Casper AP has the highest annual snowfall of all the sites with an average of nearly 80 inches. This value is sharply contrasted by three sites having annual averages of 20 – 25 inches. The great disparity between the sites can attributed to Casper's proximity to Casper Mountain. The site is located at the base of the northern slopes of the mountains and is influenced by snow events which occur as a result of orographic lifting. The interpolated values (Figure 2.5-9) show the project region having averages near 40 inches. This value agrees well with the Wyoming Climate Atlas (Martner, 1986) which lists averages for southwestern Campbell County at 40-50 inches. Substantial monthly averages (more than 3 in/month) occur for half the year and "measurable" averages (>1 in/month) for 2/3 of the year (Figure 2.5-10).

**Figure 2.5-7 Regional Annual Average Precipitation**

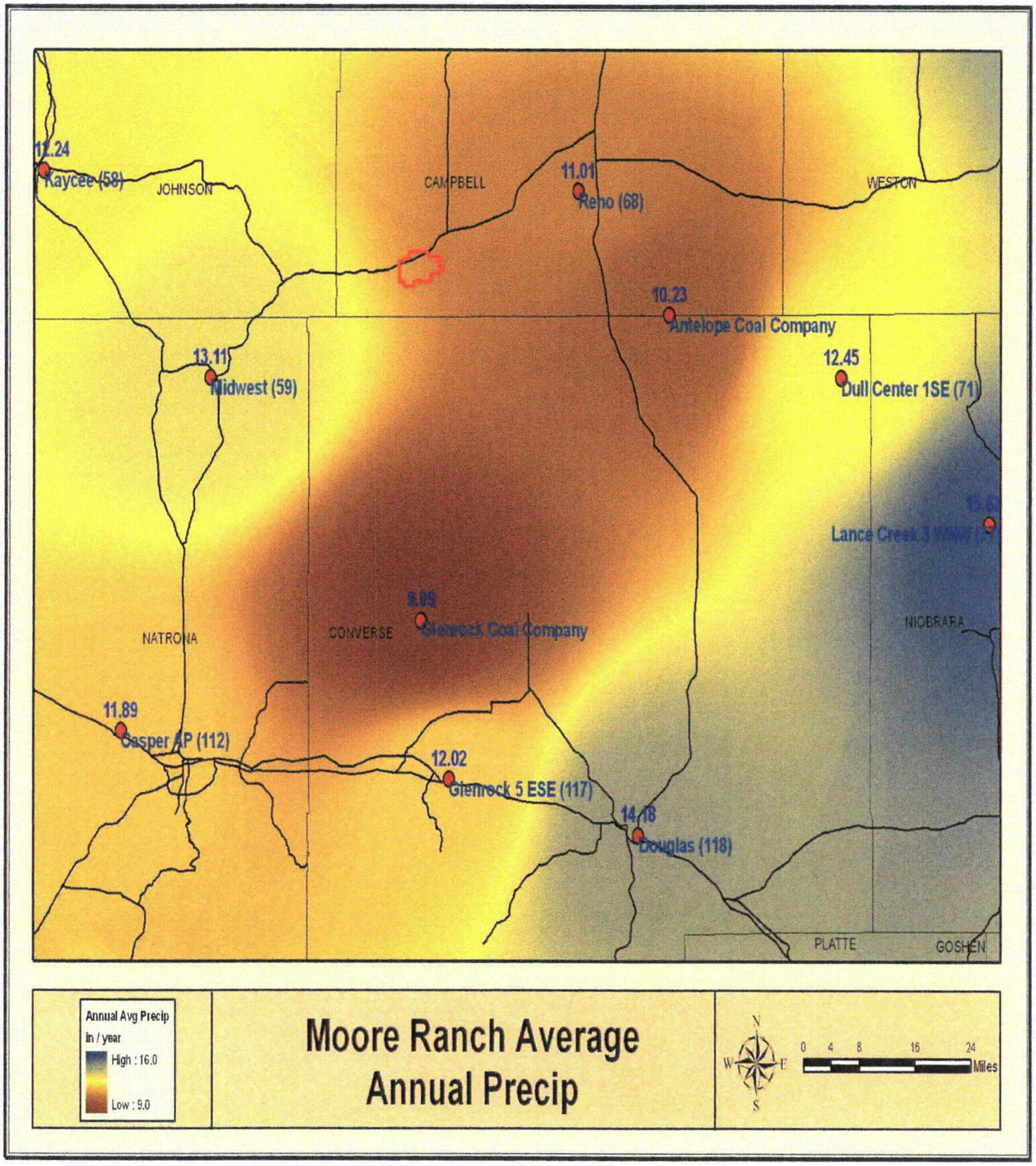


**Figure 2.5-8 NWS Station Monthly Precipitation Averages (NCDC, 2007)**

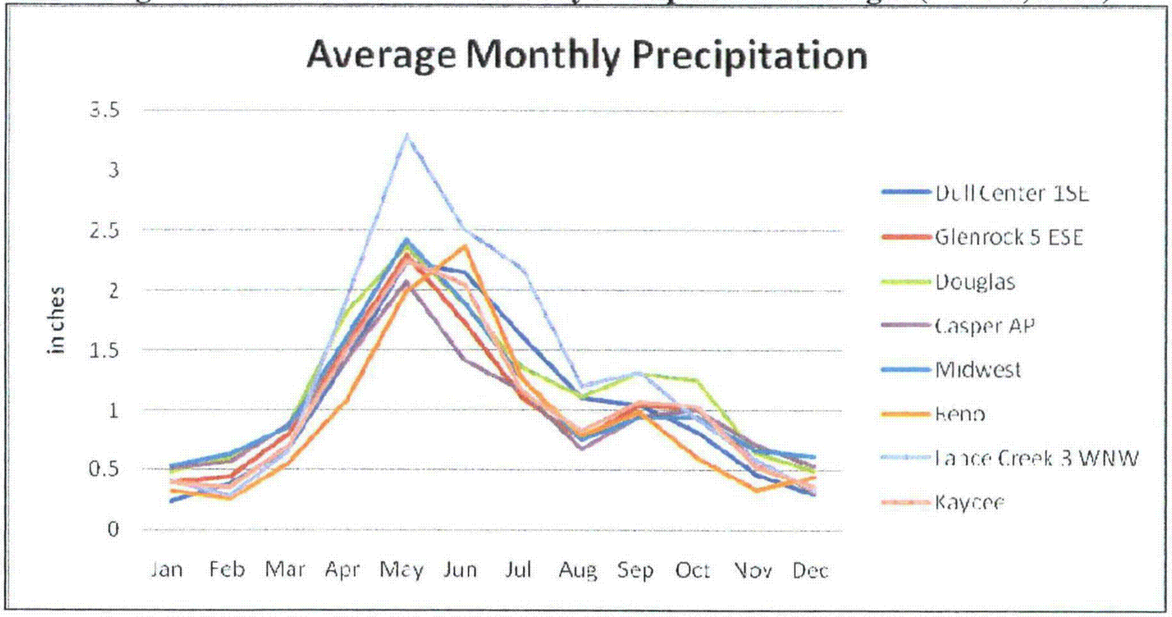


**Figure 2.5-9 Regional Annual Average Snowfall**

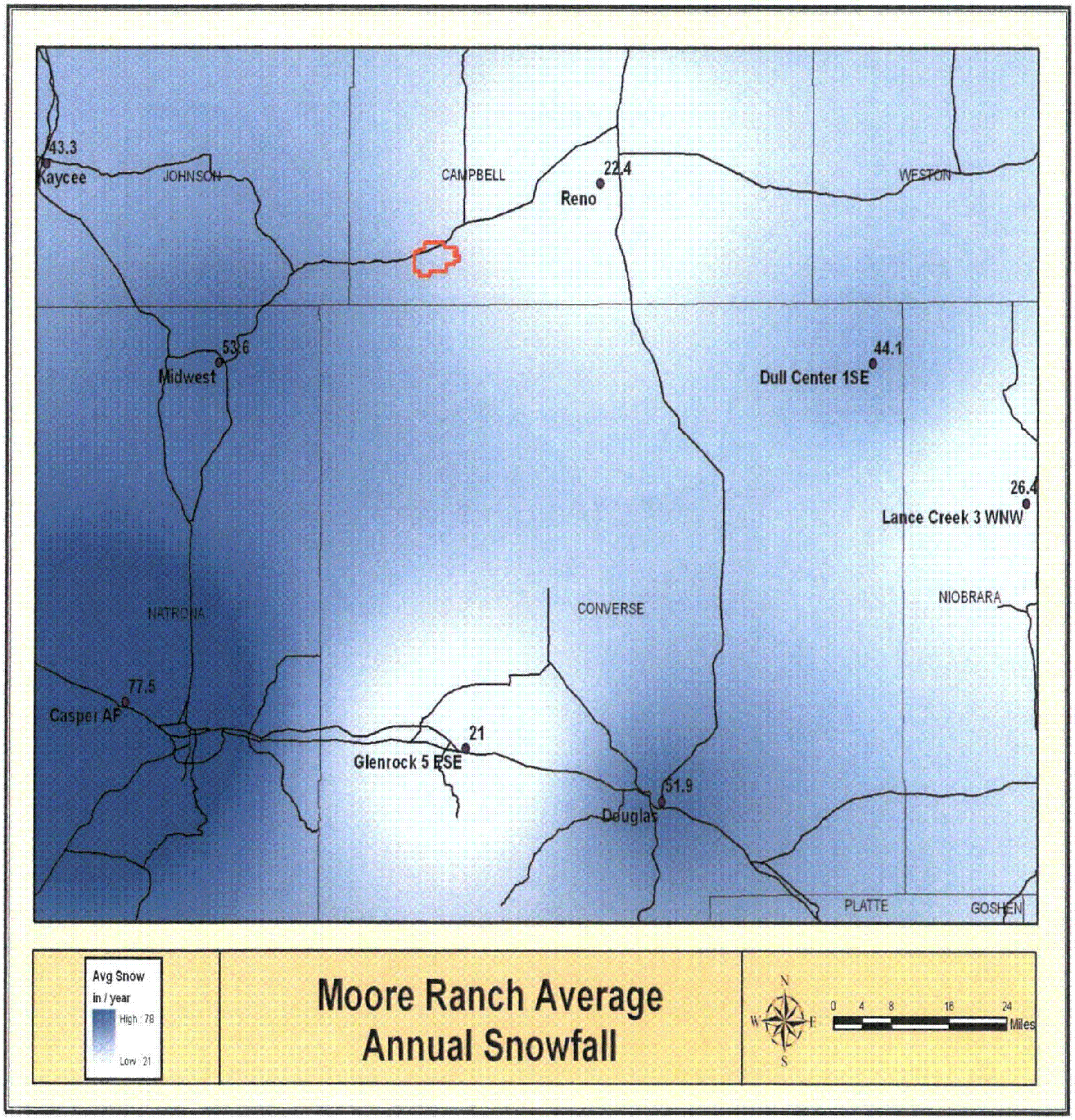
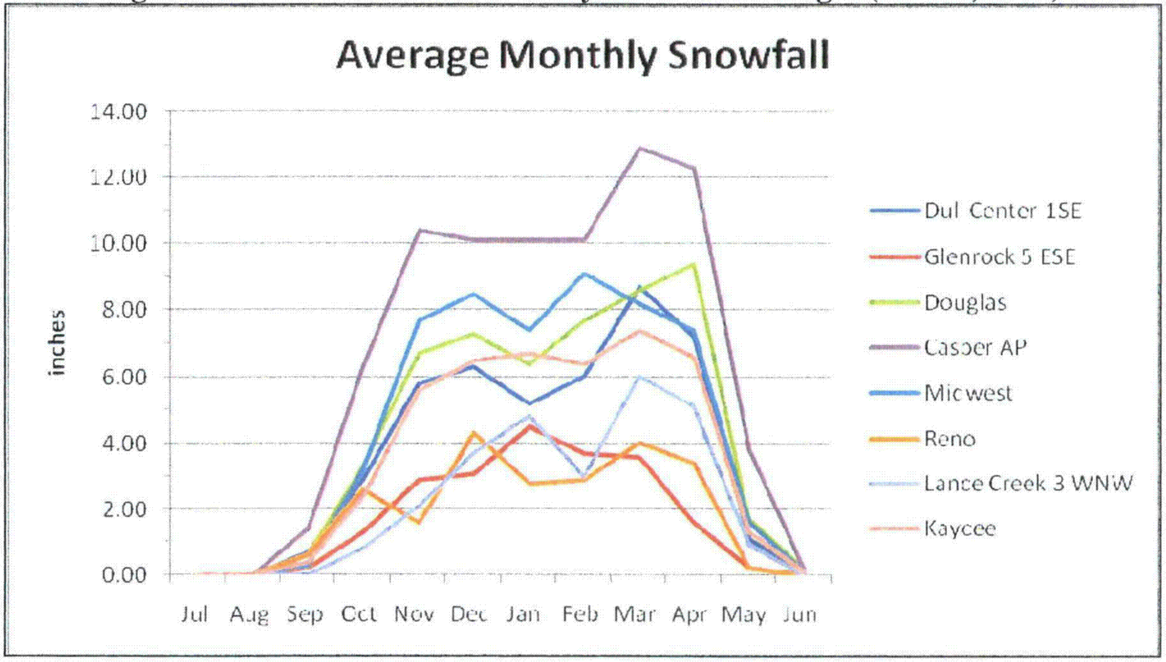


**Figure 2.5-10 NWS Station Monthly Snowfall Averages (NCDC, 2007)**




2.5.2.4 Wind Patterns

The Casper AP site averaged 12.8 mph for the 50+ years included in its climate database. The wind patterns throughout the region show very little variability. Strong west/southwesterly winds frequent the region. More than 40% of the time the wind direction is from the southwest to west sectors and accompanying wind speeds are generally fairly high with averages greater than 12 mph nearly 75% of the time. Mean monthly values from the Casper AP show July having the lowest value of 10.1 mph and January the highest at 16.3 mph. (Table 2.5-3) shows the monthly wind speed and direction averages along with monthly gust values. NWS direction data are summarized to the nearest 10 degrees. High wind events are a regular event as gust data from the Casper AP shows every month recording wind gusts greater than 60 mph. Little change is evident in the predominant seasonal wind directions. Spring and summer show west/southwest as the predominant direction, with southwest winds dominating fall and winter.

**Table 2.5-3 Casper AP Monthly Wind Parameters Summary (WRCC, 2007)**

| | Wind Speed | Wind Direction | Wind Gust |
|---|---|---|---|
| JAN | 16.3 | SW | 67 |
| FEB | 15.0 | SW | 64 |
| MAR | 13.8 | SW | 63 |
| APR | 12.6 | WSW | 60 |
| MAY | 12.6 | WSW | 64 |
| JUN | 11.0 | WSW | 64 |
| JUL | 10.1 | WSW | 60 |
| AUG | 10.3 | SW | 62 |
| SEP | 10.9 | WSW | 63 |
| OCT | 12.0 | SW | 62 |
| NOV | 14.4 | SW | 60 |
| DEC | 16.0 | SW | 66 |
| **ANN** | **12.8** | **SW** | **67** |

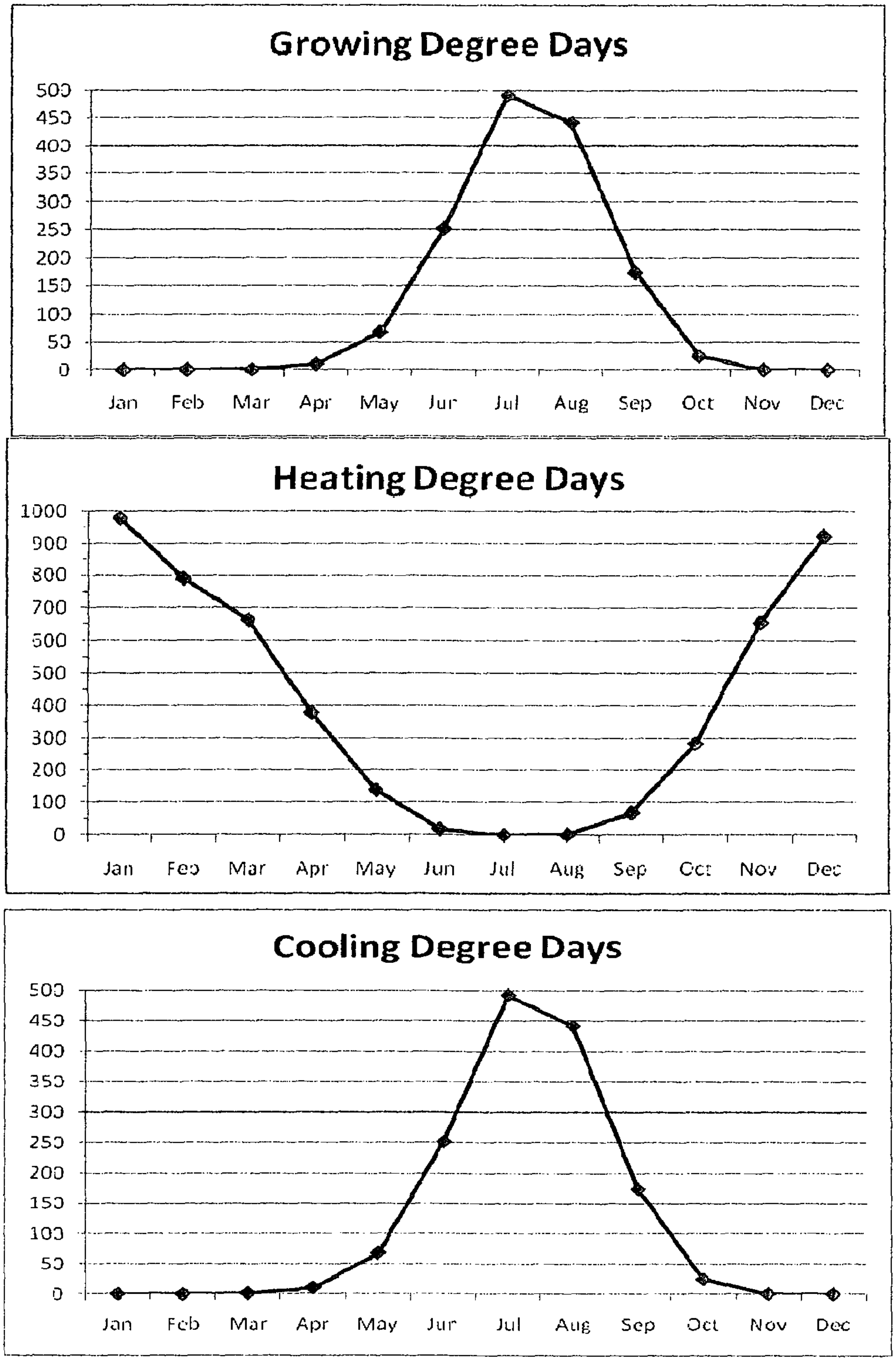
2.5.2.5 Cooling, Heating, and Growing Degree Days

The graphs shown on the next page (Figure 2.5-11) summarize the cooling, heating, and growing degree days for Casper. The data are assumed to be indicative of the region as the other meteorological parameters for the various sites track very closely.

The heating and cooling degree days are included to show deviation of the average daily temperature from a predefined base temperature. In this case, 55° F has been selected as the base temperature. The number of heating degree days is computed by taking the average of the high and low temperature occurring that day and subtracting it from the base temperature. The calculation for computing growing and cooling degree days is the same. The number of days is computed in the opposite fashion as the base temperature is subtracted from the average of the high and low temperature for the day. Negative values are disregarded for both calculations.

As expected, the heating degree days and cooling degree days are inversely proportional and the number of growing and cooling degree days are identical when the same base temperature is chosen. The maximum number of heating degree days occurs in January, 980 degree days, which coincides with January having the lowest minimum average temperature. Conversely, July registers the most cooling/growing degree days with 492, which also corresponds to July having the highest maximum average temperature.

**Figure 2.5-11 Casper AP Cooling, Heating, and Growing Degree Days (WRCC, 2007).**



### 2.5.3 Site Specific Analysis

The site specific discussion will be limited to the meteorological data from the two mine sites, Glenrock Coal (GCC) and Antelope Coal (ACC). These two sites were chosen as surrogate sites based on their proximity and similar topographic features to the permitted region. The region is characterized by high plains, rolling hills and minor ridges. Both sites are included to provide a depiction of the differences experienced between the ridge tops and lower drainages. The vegetation types are mainly confined to native grasses with some sage brush and very sparse woody coverage. Each mine's meteorological station is surrounded by rolling hills covered with native grasses.

#### 2.5.3.1 Temperature

The annual average site temperature is 46.5 °F with temperatures for each site experiencing a maximum exceeding 98° F and minimum falling below -25° F. Figure 2.5-12 shows the seasonal average temperatures for both sites, which are nearly identical. The accompanying Table 2.5-4 provides the maximum, minimum and average seasonal temperatures for both mine sites. Average temperatures range from 30° F in the winter to 65° in the summer.

Tables 2.5-5 and 2.5-6 provide meteorological summaries for the two surrogate sites. The averages, maximums, and minimums are specified for each parameter recorded at the site along with the recovery rate for each. The recovery rates are greater than 90% for all parameters at both sites with the exception of sigma theta at GCC which had a recovery rate of 89%.

**Table 2.5-4 ACC and GCC Max, Min, and Average Seasonal Temps (°F)**

| | ACC | | | GCC | | |
|---|---|---|---|---|---|---|
| | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** |
| **Winter** | 29.2 | 76.2 | -35.7 | 28.5 | 70 | -25 |
| **Spring** | 53.4 | 98.5 | 3.6 | 51.6 | 92.7 | 0 |
| **Summer** | 66.7 | 102.1 | 21.7 | 65.7 | 97.4 | 21.7 |
| **Fall** | 34.9 | 84.4 | -39.9 | 35.3 | 78.7 | -18.9 |

**Figure 2.5-12. ACC and GCC Seasonal Average Temperatures °F**

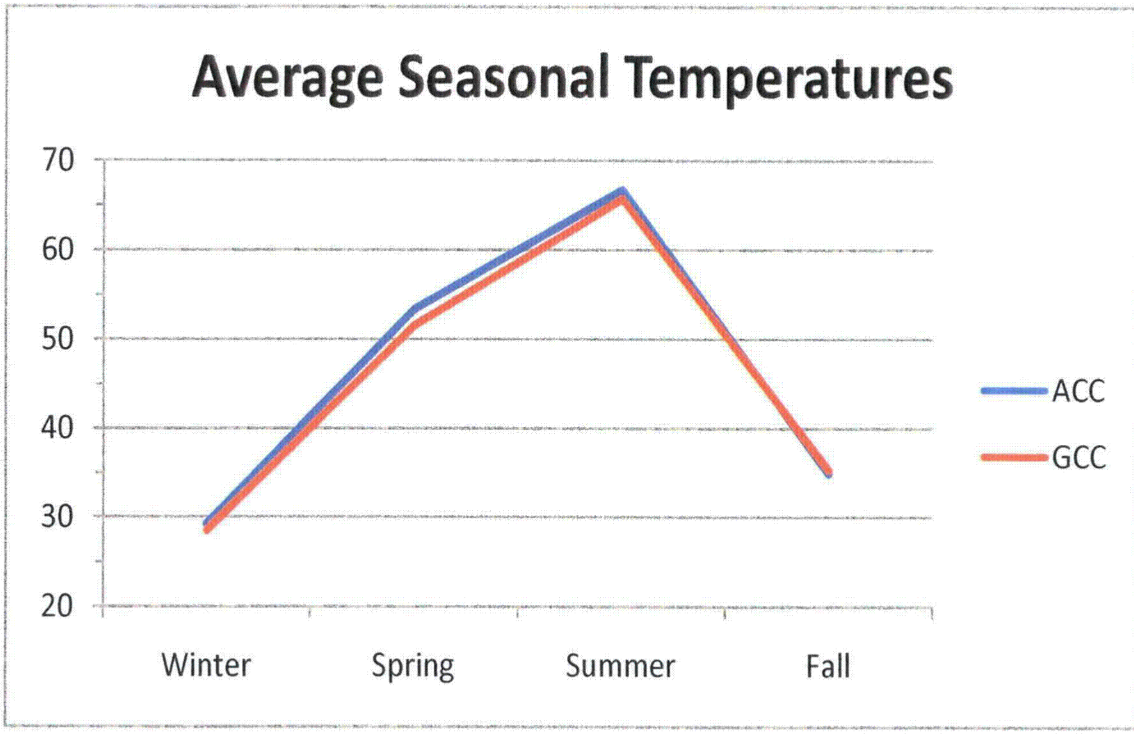


**Table 2.5-5 ACC Meteorological Summary for January 1997-December 2006**

**Hourly Data**

| | Average/Total | Max | Min |
|---|---|---|---|
| Wind Speed (mph) | 11.2 | 50.6 | 0.0 |
| Sigma-Theta (°) | 16.3 | 82.0 | 0.4 |
| Temperature (F) | 47.5 | 102.1 | -33.8 |
| Precipitation (in) | 102.34 | 1.48 | |

Predominant wind direction was from the W sector, accounting for 15.2% of the possible winds

**Data Recovery**

| Parameter | Possible (hours) | Reported (hours) | Recovery |
|---|---|---|---|
| Wind Speed | 87648 | 81938 | 93.49% |
| Wind Direction | 87648 | 81951 | 93.50% |
| Sigma-Theta | 87648 | 81951 | 93.50% |
| Temperature | 87648 | 83702 | 95.50% |
| Precipitation | 87648 | 83705 | 95.50% |

**Table 2.5-6 GCC Meteorological Summary for January 1997-December 2006**

**Hourly Data**

| | Average/Total | Max | Min |
|---|---|---|---|
| Wind Speed (mph) | 14.8 | 57.6 | 0.0 |
| Sigma-Theta (°) | 11.0 | 79.3 | 0.0 |
| Temperature (F) | 46.1 | 97.4 | -25.0 |
| Precipitation (in) | 89.92 | 1.56 | |

Predominant wind direction was from the W/SW sector, accounting for 20.0% of the possible winds

**Data Recovery**

| Parameter | Possible (hours) | Reported (hours) | Recovery |
|---|---|---|---|
| Wind Speed | 87648 | 81406 | 92.88% |
| Wind Direction | 87648 | 81406 | 92.88% |
| Sigma-Theta | 87648 | 78171 | 89.19% |
| Temperature | 87648 | 81376 | 92.84% |
| Precipitation | 87648 | 82827 | 94.50% |

2.5.3.2 Wind Patterns

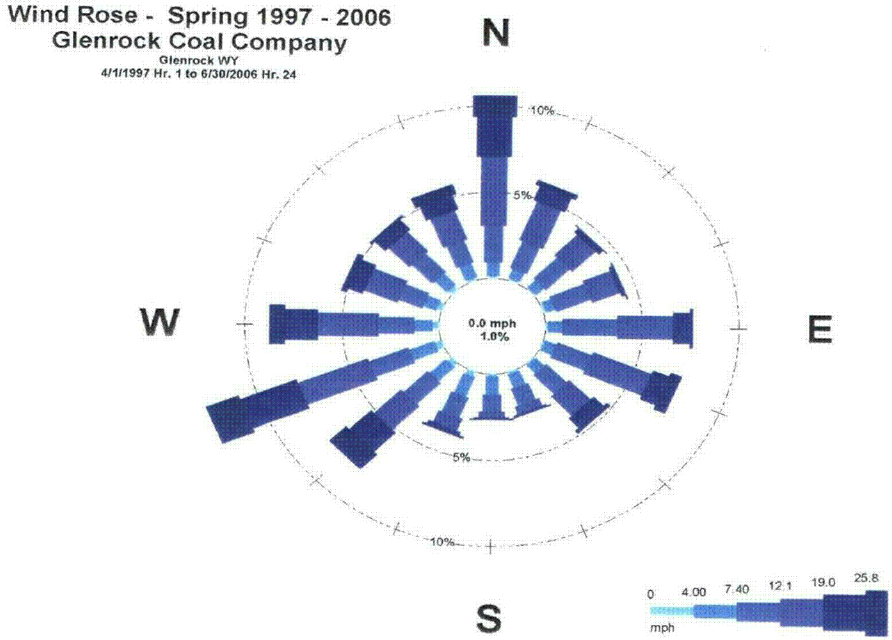
Figure 2.5-13 and Figure 2.5-14 show the seasonal wind roses for GCC and ACC, respectively. The GCC predominant wind direction is west/southwest and the ACC predominant wind direction is west with a secondary maximum of west/southwest. High pressure located over the southwestern United States is the culprit for the strong west/southwesterly winds which frequent the region. Spring experiences the greatest variability in wind direction with secondary modes from the southeast/east and northerly directions. The modes are a result of the synoptic scale transition period that occurs during this time. Low pressure regions develop on the lee side of the Rockies bringing southeast/easterly winds during development. As the low pressure systems form and move off with the general atmospheric flow, winds switch to a northerly direction.

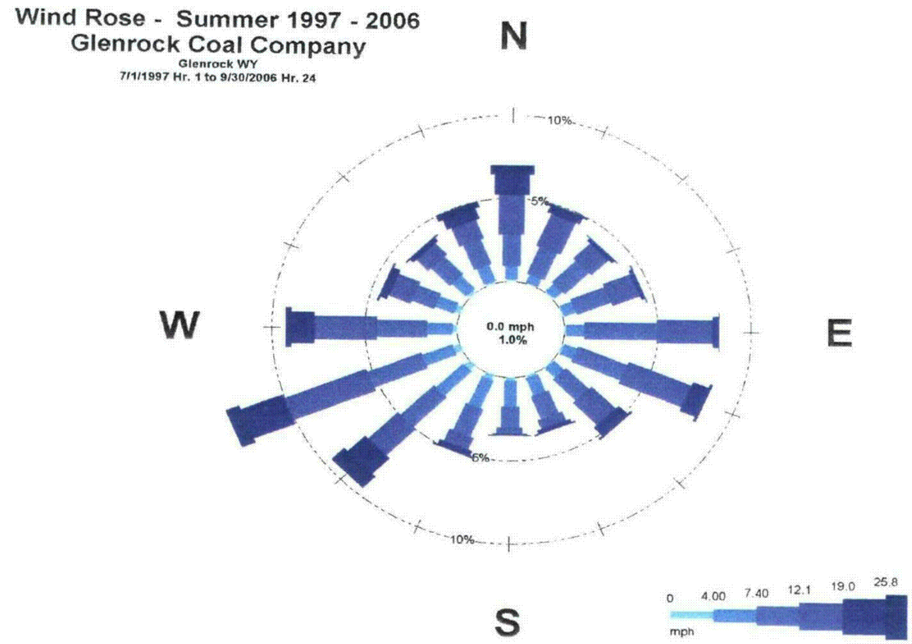
The monthly and seasonal wind speeds are summarized in Figures 2.5-15 and 2.5-16. The graphs show a pronounced difference between the winter and summer averages. GCC experiences higher wind speeds, but the seasonal changes seem to mirror each other. Late fall and winter time averages are in the upper teens while summer time averages dip into the upper single digits to low teens. Overall, sites see differences of 3-4 mph from summer to winter months.

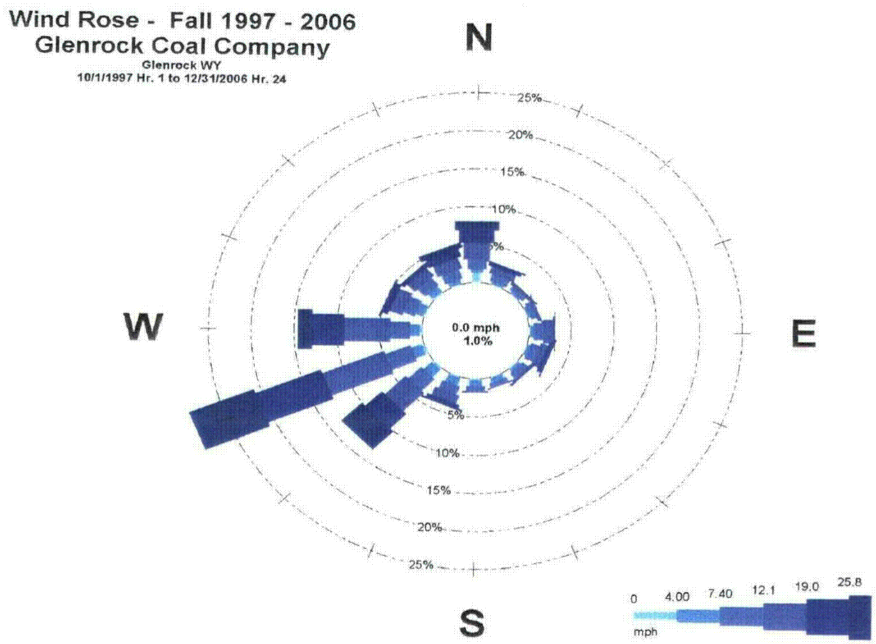
The site average for GCC is 14.8 mph for the entire ten year period analyzed and 11.1 mph for ACC. A closer look at the wind speed, summarized in the ACC and GCC wind summaries (Table 2.5-7 and Table 2.5-8), shows the west/southwesterly component average wind speed is 19.4 mph for GCC and 15.8 mph for ACC. The values suggest that the predominant wind direction is comprised of high, sustained wind speeds. Maximum hourly averages of greater 50 mph have been recorded at both mine sites. Figure 2.5-17 shows the cumulative frequency wind speed distributions for ACC and GCC. It is clearly evident from the graphs that light wind speeds are a rare occurrence.

The Joint Frequency Distributions are included for GCC (Table 2.5-9) and ACC (Table 2.5-10). The distributions show the frequencies of average wind speed for each direction based on stability class. Seventy percent of all winds at GCC and better than 56% at ACC fall into stability class D which represents near neutral to slightly unstable conditions. The light winds which accompany stable environments can be seen by the stability class F summaries (stable) as neither site has wind speed averages greater than 6 knots (6.9 mph).

## Figure 2.5-13. GC Seasonal Wind Roses



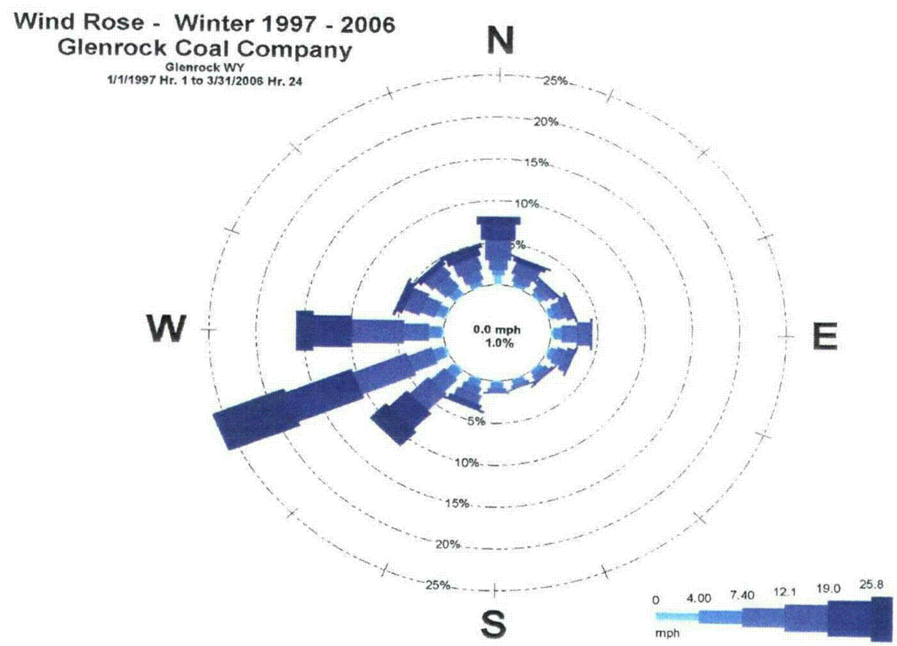



Figure 2.5-14. ACC Seasonal Wind Roses

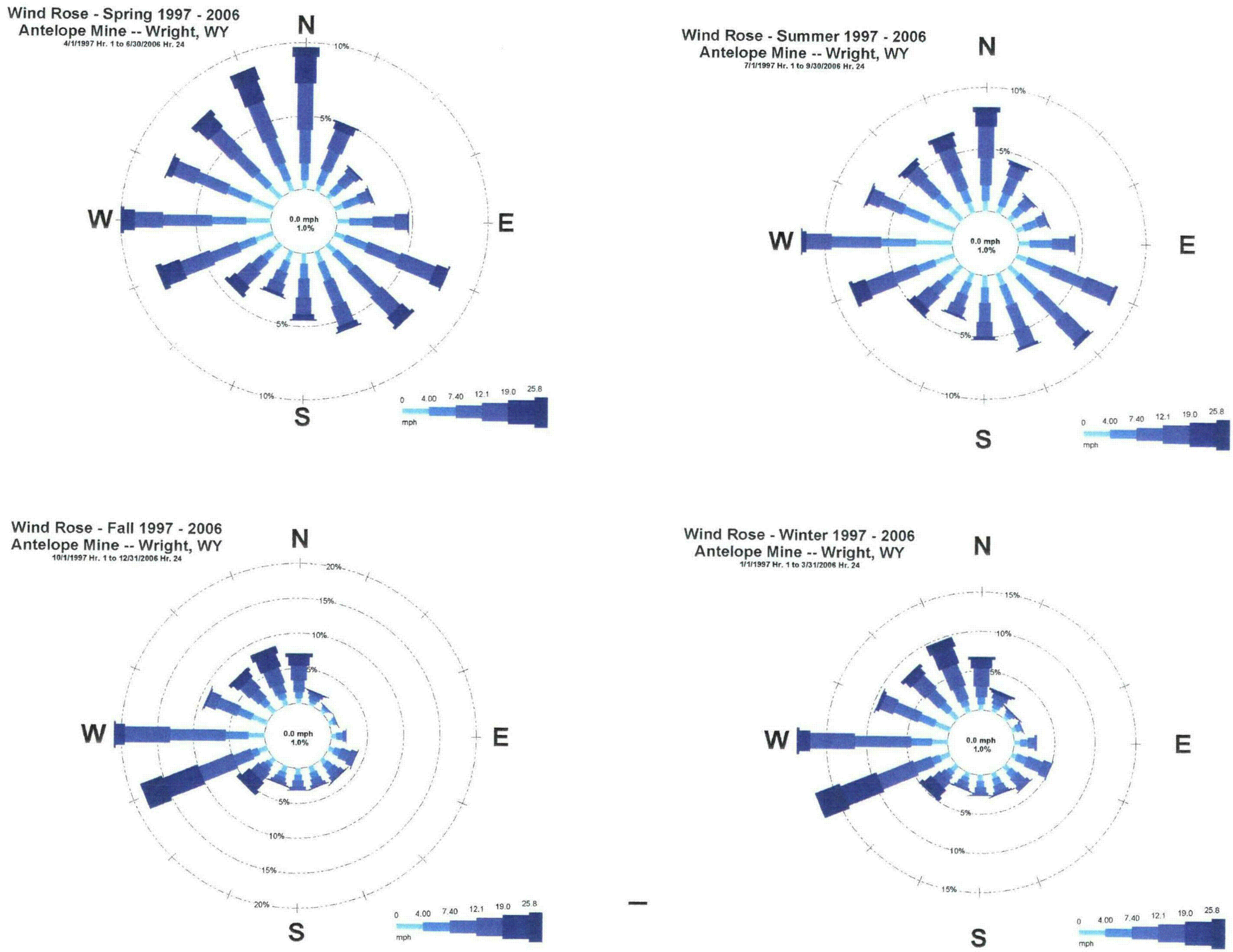


**Figure 2.5-15 Monthly Wind Speed Averages for ACC and GCC.**

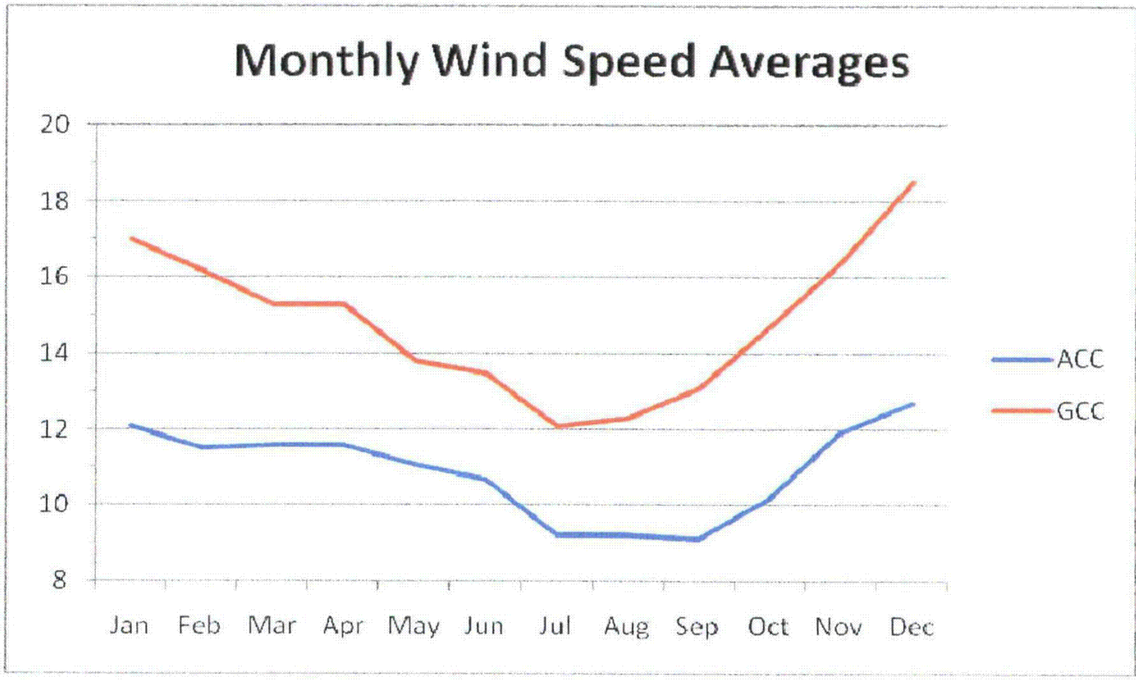
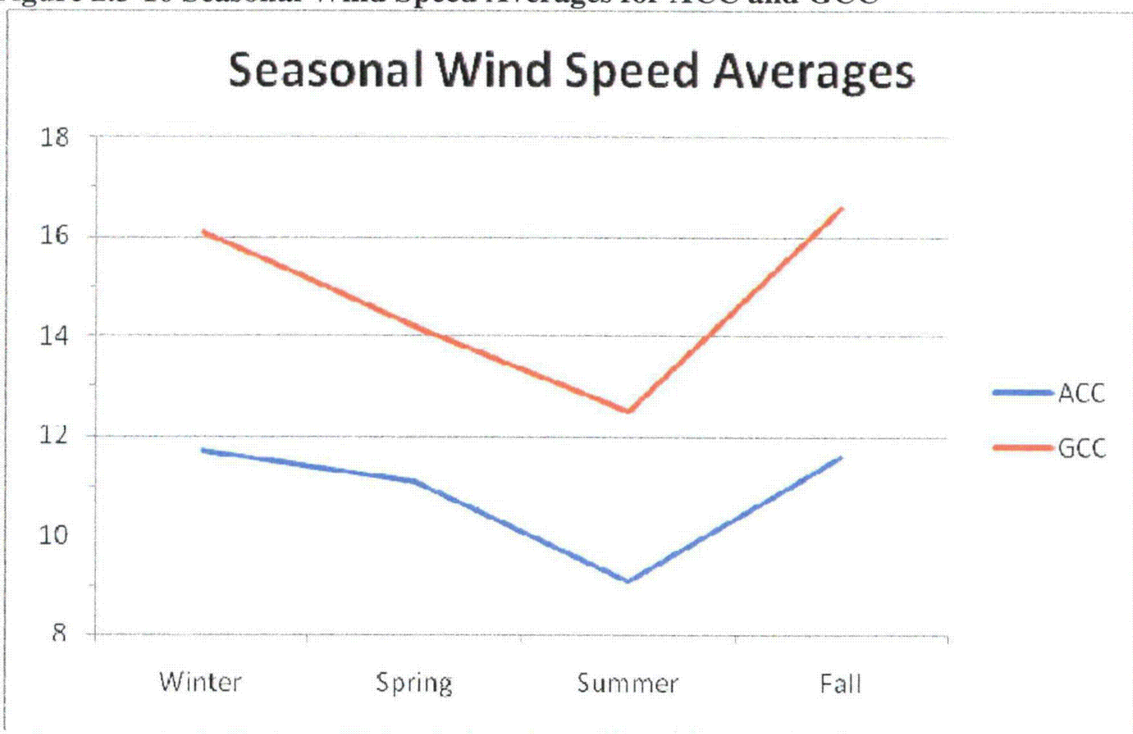



**Figure 2.5-16 Seasonal Wind Speed Averages for ACC and GCC**



# Table 2.5-7 ACC Wind Summary

## Antelope Mine

Wind Data Summary

**1/1/1997 - 12/31/2006**

**Hourly Data**

| | Average | Max | Min |
|---|---|---|---|
| Wind Speed (mph) | 11.14 | 50.60 | - |
| Sigma Theta (°) | 16.15 | 78.50 | 0.35 |
| Wind Direction | | | |
| N | 13.26 | 47.32 | 0.30 |
| NNE | 10.55 | 39.25 | 0.58 |
| NE | 7.38 | 37.61 | 0.38 |
| ENE | 6.09 | 27.41 | 0.60 |
| E | 7.34 | 28.30 | 0.56 |
| ESE | 9.94 | 33.86 | 0.50 |
| SE | 9.78 | 35.52 | 0.50 |
| SSE | 8.98 | 33.57 | 0.40 |
| S | 8.89 | 32.30 | 0.69 |
| SSW | 8.33 | 36.90 | 0.57 |
| SW | 12.64 | 41.99 | - |
| WSW | 15.79 | 50.60 | 0.09 |
| W | 10.27 | 37.90 | 0.30 |
| WNW | 8.39 | 37.40 | 0.30 |
| NW | 11.48 | 45.10 | 0.30 |
| NNW | 14.49 | 43.50 | - |

Predominant wind direction was from the W sector, accounting for 15.7% of the winds, the average wind direction was 217°.

**Data Recovery**

| | Possible (hours) | Reported (hours) | Recovery |
|---|---|---|---|
| Wind Speed | 87648 | 79756 | 91.00% |
| Sigma Theta | 87648 | 39657 | 45.25% |
| Wind Direction | 87648 | 39657 | 45.25% |

## Table 2.5-8 GCC Wind Summary

### Glenrock Coal Company

Wind Data Summary

**1/1/1997 - 12/31/2006**

**Hourly Data**

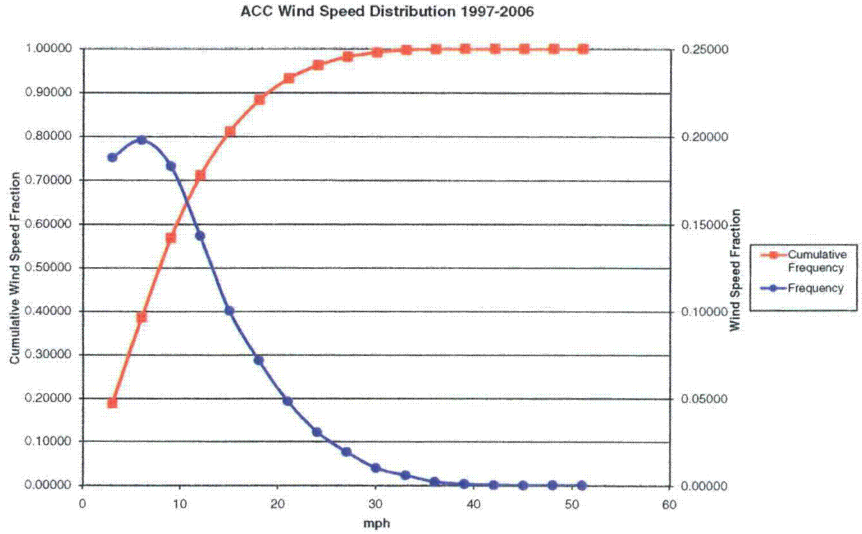
| | Average | Max | Min |
|---|---|---|---|
| Wind Speed (mph) | 14.82 | 57.60 | - |
| Sigma Theta (°) | 10.96 | 79.30 | - |
| Wind Direction | | | |
| N | 15.36 | 46.29 | - |
| NNE | 13.52 | 38.22 | - |
| NE | 11.32 | 30.90 | - |
| ENE | 11.14 | 29.80 | - |
| E | 11.92 | 37.15 | 0.10 |
| ESE | 13.52 | 38.80 | - |
| SE | 12.37 | 39.44 | - |
| SSE | 9.05 | 33.30 | 0.10 |
| S | 8.16 | 34.50 | - |
| SSW | 10.99 | 37.46 | - |
| SW | 17.09 | 55.58 | - |
| WSW | 19.36 | 57.60 | - |
| W | 15.89 | 48.21 | - |
| WNW | 12.69 | 39.44 | 0.10 |
| NW | 11.88 | 38.49 | 0.30 |
| NNW | 14.64 | 44.07 | - |

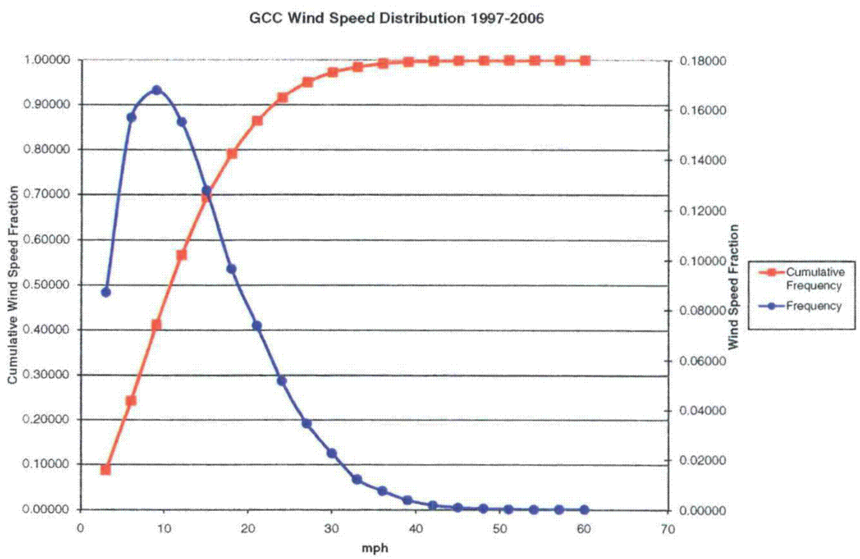
Predominant wind direction was from the WSW sector, accounting for 20% of the winds, the average wind direction was 205°.

**Data Recovery**

| | Possible (hours) | Reported (hours) | Recovery |
|---|---|---|---|
| Wind Speed | 87648 | 81406 | 92.88% |
| Sigma Theta | 87648 | 78171 | 89.19% |
| Wind Direction | 87648 | 81406 | 92.88% |

# Figure 2.5-17 ACC and GCC Wind Speed Frequency Distributions



## Table 2.5-9 GCC Joint Frequency Distribution for 1997 -2006

| | | | |
|---|---|---|---|
| Glenrock Coal Company | Frequency Distribution | | IML Air Science |
| Rolling Hills, Wyoming | Hourly Average Wind Speed, Wind Direction and Sigma | | Sheridan, WY |
| Calm Readings 334 | Total Readings 78171 | Possible Readings 87648 | Data Capture 89.2% |
| | From 1/1/1997 To 12/31/2006 | | |

**Stability Class A** — **Wind Speed (Knots)**

| **Direction** | **0.6 - 3.0** | **4 - 6** | **7 - 10** | **11-16** | **17 - 21** | **> 21** | **Row Total** |
|---|---|---|---|---|---|---|---|
| E | 0.00023 | 0.00148 | 0.00127 | 0.00006 | 0.00001 | | 0.00306 |
| ENE | 0.00030 | 0.00117 | 0.00069 | 0.00008 | 0.00001 | | 0.00225 |
| ESE | 0.00031 | 0.00122 | 0.00101 | 0.00014 | | | 0.00269 |
| N | 0.00026 | 0.00166 | 0.00159 | 0.00017 | 0.00001 | | 0.00369 |
| NE | 0.00026 | 0.00136 | 0.00109 | 0.00001 | | 0.00001 | 0.00274 |
| NNE | 0.00015 | 0.00116 | 0.00128 | 0.00015 | | | 0.00275 |
| NNW | 0.00037 | 0.00222 | 0.00127 | 0.00017 | 0.00003 | 0.00001 | 0.00407 |
| NW | 0.00046 | 0.00216 | 0.00189 | 0.00040 | 0.00001 | 0.00001 | 0.00493 |
| S | 0.00026 | 0.00167 | 0.00089 | 0.00022 | 0.00003 | | 0.00306 |
| SE | 0.00024 | 0.00105 | 0.00093 | 0.00014 | | | 0.00236 |
| SSE | 0.00027 | 0.00143 | 0.00110 | 0.00010 | | | 0.00290 |
| SSW | 0.00048 | 0.00207 | 0.00112 | 0.00024 | | | 0.00391 |
| SW | 0.00045 | 0.00230 | 0.00204 | 0.00045 | 0.00001 | | 0.00525 |
| W | 0.00045 | 0.00170 | 0.00247 | 0.00069 | 0.00009 | 0.00003 | 0.00542 |
| WNW | 0.00055 | 0.00170 | 0.00182 | 0.00030 | 0.00001 | 0.00001 | 0.00439 |
| WSW | 0.00048 | 0.00216 | 0.00227 | 0.00060 | 0.00006 | | 0.00558 |
| **Sum** | 0.00551 | 0.02649 | 0.02275 | 0.00393 | 0.00028 | 0.00008 | 0.05905 |

## Table 2.5-9 GCC Joint Frequency Distribution for 1997 -2006 (Continued)

**Stability Class B** **Wind Speed (Knots)**

| Direction | 0.6 - 3.0 | 4 - 6 | 7 - 10 | 11-16 | 17 - 21 | > 21 | Row Total |
|---|---|---|---|---|---|---|---|
| E | 0.00008 | 0.00026 | 0.00049 | 0.00024 | | | 0.00107 |
| ENE | 0.00005 | 0.00018 | 0.00057 | 0.00009 | | | 0.00089 |
| ESE | 0.00009 | 0.00018 | 0.00084 | 0.00024 | | | 0.00135 |
| N | 0.00003 | 0.00024 | 0.00095 | 0.00039 | 0.00003 | 0.00008 | 0.00171 |
| NE | 0.00006 | 0.00012 | 0.00049 | 0.00009 | | | 0.00076 |
| NNE | 0.00003 | 0.00026 | 0.00085 | 0.00019 | | | 0.00132 |
| NNW | 0.00004 | 0.00027 | 0.00110 | 0.00060 | 0.00005 | | 0.00207 |
| NW | 0.00012 | 0.00044 | 0.00094 | 0.00072 | 0.00004 | | 0.00225 |
| S | 0.00010 | 0.00037 | 0.00031 | 0.00021 | 0.00001 | 0.00001 | 0.00101 |
| SE | 0.00006 | 0.00026 | 0.00075 | 0.00030 | | 0.00001 | 0.00137 |
| SSE | 0.00004 | 0.00039 | 0.00041 | 0.00023 | 0.00001 | | 0.00108 |
| SSW | 0.00012 | 0.00048 | 0.00066 | 0.00058 | 0.00004 | | 0.00186 |
| SW | 0.00023 | 0.00059 | 0.00116 | 0.00119 | 0.00019 | 0.00005 | 0.00342 |
| W | 0.00017 | 0.00054 | 0.00168 | 0.00177 | 0.00019 | 0.00008 | 0.00443 |
| WNW | 0.00014 | 0.00037 | 0.00096 | 0.00100 | 0.00010 | | 0.00258 |
| WSW | 0.00022 | 0.00051 | 0.00130 | 0.00167 | 0.00021 | 0.00005 | 0.00396 |
| **Sum** | 0.00157 | 0.00545 | 0.01344 | 0.00952 | 0.00087 | 0.00028 | 0.03113 |

### Table 2.5-9 GCC Joint Frequency Distribution for 1997 -2006 (Continued)

**Stability Class C** — **Wind Speed (Knots)**

| **Direction** | **0.6 - 3.0** | **4 - 6** | **7 - 10** | **11-16** | **17 - 21** | **> 21** | **Row Total** |
|---|---|---|---|---|---|---|---|
| E | 0.00008 | 0.00044 | 0.00087 | 0.00081 | | | 0.00220 |
| ENE | 0.00008 | 0.00028 | 0.00062 | 0.00040 | | 0.00001 | 0.00139 |
| ESE | 0.00003 | 0.00045 | 0.00094 | 0.00132 | 0.00003 | | 0.00276 |
| N | 0.00009 | 0.00032 | 0.00154 | 0.00297 | 0.00135 | 0.00099 | 0.00726 |
| NE | 0.00003 | 0.00015 | 0.00089 | 0.00044 | | | 0.00150 |
| NNE | 0.00003 | 0.00030 | 0.00099 | 0.00118 | 0.00001 | | 0.00251 |
| NNW | 0.00006 | 0.00058 | 0.00140 | 0.00161 | 0.00037 | 0.00013 | 0.00415 |
| NW | 0.00013 | 0.00048 | 0.00131 | 0.00209 | 0.00049 | 0.00009 | 0.00459 |
| S | 0.00010 | 0.00066 | 0.00051 | 0.00042 | 0.00010 | 0.00001 | 0.00181 |
| SE | 0.00008 | 0.00054 | 0.00117 | 0.00131 | 0.00006 | 0.00001 | 0.00317 |
| SSE | 0.00009 | 0.00045 | 0.00062 | 0.00045 | 0.00003 | 0.00001 | 0.00164 |
| SSW | 0.00013 | 0.00075 | 0.00104 | 0.00091 | 0.00037 | 0.00006 | 0.00326 |
| SW | 0.00026 | 0.00091 | 0.00189 | 0.00297 | 0.00143 | 0.00027 | 0.00772 |
| W | 0.00022 | 0.00080 | 0.00164 | 0.00441 | 0.00159 | 0.00035 | 0.00901 |
| WNW | 0.00012 | 0.00050 | 0.00121 | 0.00276 | 0.00067 | 0.00015 | 0.00541 |
| WSW | 0.00026 | 0.00089 | 0.00247 | 0.00511 | 0.00226 | 0.00059 | 0.01158 |
| **Sum** | 0.00176 | 0.00848 | 0.01910 | 0.02916 | 0.00876 | 0.00269 | 0.06995 |

**Table 2.5-9 GCC Joint Frequency Distribution for 1997 -2006 (Continued)**

**Stability Class D**

**Wind Speed (Knots)**

| **Direction** | **0.6 - 3.0** | **4 - 6** | **7 - 10** | **11-16** | **17 - 21** | **> 21** | **Row Total** |
|---|---|---|---|---|---|---|---|
| E | 0.00033 | 0.00190 | 0.00957 | 0.02189 | 0.00403 | 0.00075 | 0.03848 |
| ENE | 0.00033 | 0.00112 | 0.00550 | 0.01107 | 0.00141 | 0.00026 | 0.01970 |
| ESE | 0.00027 | 0.00202 | 0.00903 | 0.02149 | 0.00591 | 0.00281 | 0.04154 |
| N | 0.00032 | 0.00258 | 0.00951 | 0.02536 | 0.01484 | 0.01046 | 0.06307 |
| NE | 0.00014 | 0.00119 | 0.00497 | 0.01015 | 0.00161 | 0.00026 | 0.01832 |
| NNE | 0.00013 | 0.00134 | 0.00545 | 0.01611 | 0.00495 | 0.00203 | 0.03000 |
| NNW | 0.00040 | 0.00247 | 0.00641 | 0.01381 | 0.00714 | 0.00641 | 0.03664 |
| NW | 0.00067 | 0.00375 | 0.00723 | 0.01043 | 0.00365 | 0.00175 | 0.02748 |
| S | 0.00040 | 0.00335 | 0.00325 | 0.00166 | 0.00039 | 0.00008 | 0.00912 |
| SE | 0.00008 | 0.00238 | 0.00567 | 0.00879 | 0.00384 | 0.00119 | 0.02194 |
| SSE | 0.00035 | 0.00258 | 0.00353 | 0.00245 | 0.00076 | 0.00022 | 0.00989 |
| SSW | 0.00075 | 0.00445 | 0.00579 | 0.00523 | 0.00132 | 0.00078 | 0.01832 |
| SW | 0.00082 | 0.00561 | 0.00949 | 0.01742 | 0.01382 | 0.02167 | 0.06885 |
| W | 0.00068 | 0.00567 | 0.01377 | 0.03848 | 0.02288 | 0.01382 | 0.09530 |
| WNW | 0.00053 | 0.00412 | 0.00763 | 0.01314 | 0.00501 | 0.00244 | 0.03288 |
| WSW | 0.00107 | 0.00624 | 0.01566 | 0.05036 | 0.04394 | 0.05395 | 0.17122 |
| **Sum** | 0.00726 | 0.05077 | 0.12247 | 0.26785 | 0.13550 | 0.11888 | 0.70274 |

## Table 2.5-9 GCC Joint Frequency Distribution for 1997 -2006 (Continued)

**Stability Class E** **Wind Speed (Knots)**

| Direction | 0.6 - 3.0 | 4 - 6 | 7 - 10 | 11-16 | 17 - 21 | > 21 | Row Total |
|---|---|---|---|---|---|---|---|
| E | 0.00049 | 0.00257 | 0.01188 | | | | 0.01494 |
| ENE | 0.00019 | 0.00164 | 0.00686 | | | | 0.00870 |
| ESE | 0.00037 | 0.00159 | 0.00609 | | | | 0.00806 |
| N | 0.00030 | 0.00143 | 0.00313 | | | | 0.00486 |
| NE | 0.00019 | 0.00153 | 0.00443 | | | | 0.00615 |
| NNE | 0.00014 | 0.00141 | 0.00446 | | | | 0.00601 |
| NNW | 0.00031 | 0.00184 | 0.00356 | | | | 0.00570 |
| NW | 0.00028 | 0.00218 | 0.00373 | | | | 0.00619 |
| S | 0.00055 | 0.00425 | 0.00376 | | | | 0.00857 |
| SE | 0.00026 | 0.00140 | 0.00376 | | | | 0.00542 |
| SSE | 0.00039 | 0.00283 | 0.00352 | | | | 0.00673 |
| SSW | 0.00082 | 0.00433 | 0.00380 | | | | 0.00895 |
| SW | 0.00072 | 0.00398 | 0.00420 | | | | 0.00890 |
| W | 0.00060 | 0.00224 | 0.00424 | | | | 0.00708 |
| WNW | 0.00046 | 0.00199 | 0.00265 | | | | 0.00510 |
| WSW | 0.00089 | 0.00298 | 0.00403 | | | | 0.00790 |
| **Sum** | 0.00696 | 0.03820 | 0.07412 | | | | 0.11927 |

**Table 2.5-9 GCC Joint Frequency Distribution for 1997 -2006 (Continued)**

**Stability Class F** **Wind Speed (Knots)**

| Direction | 0.6 - 3.0 | 4 - 6 | 7 - 10 | 11-16 | 17 - 21 | > 21 | Row Total |
|---|---|---|---|---|---|---|---|
| E | 0.00045 | 0.00077 | | | | | 0.00122 |
| ENE | 0.00050 | 0.00067 | | | | | 0.00117 |
| ESE | 0.00039 | 0.00054 | | | | | 0.00093 |
| N | 0.00033 | 0.00040 | | | | | 0.00073 |
| NE | 0.00036 | 0.00046 | | | | | 0.00082 |
| NNE | 0.00027 | 0.00050 | | | | | 0.00077 |
| NNW | 0.00031 | 0.00059 | | | | | 0.00090 |
| NW | 0.00051 | 0.00068 | | | | | 0.00119 |
| S | 0.00041 | 0.00067 | | | | | 0.00108 |
| SE | 0.00040 | 0.00053 | | | | | 0.00093 |
| SSE | 0.00042 | 0.00046 | | | | | 0.00089 |
| SSW | 0.00039 | 0.00054 | | | | | 0.00093 |
| SW | 0.00068 | 0.00060 | | | | | 0.00128 |
| W | 0.00072 | 0.00103 | | | | | 0.00175 |
| WNW | 0.00077 | 0.00077 | | | | | 0.00154 |
| WSW | 0.00071 | 0.00103 | | | | | 0.00173 |
| **Sum** | 0.00762 | 0.01024 | | | | | 0.01786 |

## Table 2.5-10 ACC Joint Frequency Distribution for 1997-2006

Antelope Coal Company
Wright, Wyoming
Calm Readings 28

Frequency Distribution
Hourly Average Wind Speed, Wind Direction and Sigma
Total Readings 81938 Possible Readings 87648
From 1/1/1997 To 12/31/2006

IML Air Science
Sheridan, WY
Data Capture 93.5%

**Stability Class A**

| | Wind Speed (Knots) | | | | | | |
|---|---|---|---|---|---|---|---|
| **Direction** | **0.6 - 3.0** | **4 - 6** | **7 - 10** | **11-16** | **17 - 21** | **> 21** | **Row Total** |
| E | 0.00226 | 0.00203 | 0.00076 | 0.00001 | | | 0.00505 |
| ENE | 0.00193 | 0.00214 | 0.00039 | 0.00006 | | | 0.00452 |
| ESE | 0.00192 | 0.00212 | 0.00088 | 0.00016 | | | 0.00508 |
| N | 0.00259 | 0.00260 | 0.00193 | 0.00013 | 0.00005 | | 0.00730 |
| NE | 0.00175 | 0.00204 | 0.00070 | 0.00009 | | | 0.00457 |
| NNE | 0.00183 | 0.00264 | 0.00098 | 0.00005 | 0.00002 | | 0.00552 |
| NNW | 0.00261 | 0.00278 | 0.00173 | 0.00021 | 0.00001 | | 0.00735 |
| NW | 0.00316 | 0.00316 | 0.00217 | 0.00028 | | | 0.00878 |
| S | 0.00164 | 0.00273 | 0.00125 | 0.00016 | | | 0.00577 |
| SE | 0.00175 | 0.00295 | 0.00133 | 0.00009 | 0.00001 | | 0.00613 |
| SSE | 0.00165 | 0.00289 | 0.00138 | 0.00012 | | | 0.00604 |
| SSW | 0.00134 | 0.00236 | 0.00111 | 0.00006 | 0.00002 | | 0.00490 |
| SW | 0.00172 | 0.00205 | 0.00131 | 0.00031 | 0.00010 | 0.00011 | 0.00559 |
| W | 0.00271 | 0.00333 | 0.00206 | 0.00032 | 0.00002 | 0.00002 | 0.00847 |
| WNW | 0.00342 | 0.00360 | 0.00225 | 0.00032 | 0.00001 | | 0.00960 |
| WSW | 0.00190 | 0.00282 | 0.00193 | 0.00031 | 0.00010 | 0.00001 | 0.00707 |
| **Sum** | 0.03417 | 0.04225 | 0.02215 | 0.00266 | 0.00035 | 0.00015 | 0.10173 |

## Table 2.5-10 ACC Joint Frequency Distribution for 1997-2006 (Continued)

**Stability Class B** **Wind Speed (Knots)**

| Direction | 0.6 - 3.0 | 4 - 6 | 7 - 10 | 11-16 | 17 - 21 | > 21 | Row Total |
|---|---|---|---|---|---|---|---|
| E | 0.00042 | 0.00048 | 0.00049 | 0.00004 | | | 0.00142 |
| ENE | 0.00027 | 0.00024 | 0.00038 | 0.00004 | | | 0.00093 |
| ESE | 0.00026 | 0.00039 | 0.00095 | 0.00018 | | | 0.00178 |
| N | 0.00023 | 0.00055 | 0.00164 | 0.00063 | 0.00002 | 0.00001 | 0.00309 |
| NE | 0.00021 | 0.00024 | 0.00055 | 0.00006 | | | 0.00106 |
| NNE | 0.00015 | 0.00049 | 0.00088 | 0.00017 | 0.00001 | | 0.00170 |
| NNW | 0.00024 | 0.00057 | 0.00139 | 0.00077 | 0.00002 | 0.00004 | 0.00304 |
| NW | 0.00061 | 0.00070 | 0.00154 | 0.00082 | 0.00002 | 0.00002 | 0.00371 |
| S | 0.00024 | 0.00055 | 0.00089 | 0.00028 | 0.00002 | | 0.00199 |
| SE | 0.00033 | 0.00079 | 0.00134 | 0.00033 | | | 0.00280 |
| SSE | 0.00023 | 0.00078 | 0.00120 | 0.00032 | 0.00001 | | 0.00254 |
| SSW | 0.00020 | 0.00031 | 0.00059 | 0.00021 | 0.00001 | | 0.00131 |
| SW | 0.00016 | 0.00039 | 0.00054 | 0.00048 | 0.00009 | 0.00005 | 0.00170 |
| W | 0.00066 | 0.00110 | 0.00183 | 0.00096 | 0.00004 | | 0.00459 |
| WNW | 0.00087 | 0.00090 | 0.00166 | 0.00101 | 0.00006 | 0.00002 | 0.00453 |
| WSW | 0.00039 | 0.00054 | 0.00128 | 0.00127 | 0.00015 | 0.00010 | 0.00372 |
| **Sum** | 0.00546 | 0.00902 | 0.01714 | 0.00757 | 0.00046 | 0.00024 | 0.03990 |

**Table 2.5-10 ACC Joint Frequency Distribution for 1997-2006 (Continued)**

**Stability Class C** **Wind Speed (Knots)**

| **Direction** | **0.6 - 3.0** | **4 - 6** | **7 - 10** | **11-16** | **17 - 21** | **> 21** | **Row Total** |
|---|---|---|---|---|---|---|---|
| E | 0.00026 | 0.00063 | 0.00052 | 0.00043 | | | 0.00184 |
| ENE | 0.00017 | 0.00043 | 0.00037 | 0.00016 | | | 0.00112 |
| ESE | 0.00023 | 0.00093 | 0.00137 | 0.00096 | 0.00002 | | 0.00352 |
| N | 0.00016 | 0.00051 | 0.00266 | 0.00454 | 0.00147 | 0.00084 | 0.01018 |
| NE | 0.00010 | 0.00042 | 0.00043 | 0.00022 | 0.00001 | | 0.00117 |
| NNE | 0.00005 | 0.00054 | 0.00125 | 0.00096 | 0.00006 | 0.00002 | 0.00288 |
| NNW | 0.00012 | 0.00066 | 0.00226 | 0.00418 | 0.00101 | 0.00035 | 0.00858 |
| NW | 0.00037 | 0.00096 | 0.00226 | 0.00294 | 0.00060 | 0.00013 | 0.00726 |
| S | 0.00010 | 0.00073 | 0.00137 | 0.00099 | 0.00009 | 0.00001 | 0.00328 |
| SE | 0.00021 | 0.00089 | 0.00251 | 0.00198 | 0.00009 | | 0.00568 |
| SSE | 0.00015 | 0.00100 | 0.00214 | 0.00183 | 0.00011 | | 0.00523 |
| SSW | 0.00013 | 0.00034 | 0.00085 | 0.00085 | 0.00011 | | 0.00230 |
| SW | 0.00017 | 0.00029 | 0.00076 | 0.00160 | 0.00054 | 0.00050 | 0.00386 |
| W | 0.00057 | 0.00232 | 0.00309 | 0.00396 | 0.00068 | 0.00016 | 0.01078 |
| WNW | 0.00052 | 0.00165 | 0.00236 | 0.00286 | 0.00048 | 0.00007 | 0.00794 |
| WSW | 0.00012 | 0.00073 | 0.00136 | 0.00365 | 0.00151 | 0.00077 | 0.00814 |
| **Sum** | 0.00343 | 0.01304 | 0.02554 | 0.03211 | 0.00678 | 0.00287 | 0.08376 |

## Table 2.5-10 ACC Joint Frequency Distribution for 1997-2006 (Continued)

**Stability Class D** **Wind Speed (Knots)**

| Direction | 0.6 - 3.0 | 4 - 6 | 7 - 10 | 11-16 | 17 - 21 | > 21 | Row Total |
|---|---|---|---|---|---|---|---|
| E | 0.00074 | 0.00620 | 0.00678 | 0.00411 | 0.00032 | 0.00004 | 0.01819 |
| ENE | 0.00059 | 0.00354 | 0.00265 | 0.00087 | 0.00005 | 0.00001 | 0.00770 |
| ESE | 0.00077 | 0.00685 | 0.01279 | 0.01637 | 0.00275 | 0.00032 | 0.03985 |
| N | 0.00034 | 0.00421 | 0.01107 | 0.01977 | 0.01002 | 0.00448 | 0.04990 |
| NE | 0.00015 | 0.00227 | 0.00321 | 0.00171 | 0.00037 | 0.00011 | 0.00781 |
| NNE | 0.00022 | 0.00289 | 0.00608 | 0.00751 | 0.00241 | 0.00116 | 0.02027 |
| NNW | 0.00052 | 0.00380 | 0.00941 | 0.01935 | 0.01261 | 0.00955 | 0.05524 |
| NW | 0.00046 | 0.00438 | 0.01044 | 0.01425 | 0.00632 | 0.00420 | 0.04006 |
| S | 0.00052 | 0.00270 | 0.00504 | 0.00645 | 0.00170 | 0.00039 | 0.01680 |
| SE | 0.00063 | 0.00531 | 0.00905 | 0.01156 | 0.00287 | 0.00084 | 0.03026 |
| SSE | 0.00079 | 0.00352 | 0.00614 | 0.00752 | 0.00186 | 0.00033 | 0.02016 |
| SSW | 0.00052 | 0.00182 | 0.00364 | 0.00413 | 0.00109 | 0.00037 | 0.01156 |
| SW | 0.00043 | 0.00139 | 0.00424 | 0.01034 | 0.00708 | 0.00414 | 0.02762 |
| W | 0.00128 | 0.01170 | 0.03427 | 0.03327 | 0.00778 | 0.00226 | 0.09055 |
| WNW | 0.00096 | 0.00802 | 0.01688 | 0.01012 | 0.00215 | 0.00048 | 0.03862 |
| WSW | 0.00048 | 0.00360 | 0.01284 | 0.03002 | 0.02392 | 0.02084 | 0.09170 |
| **Sum** | 0.00942 | 0.07220 | 0.15454 | 0.19734 | 0.08327 | 0.04951 | 0.56628 |

**Table 2.5-10 ACC Joint Frequency Distribution for 1997-2006 (Continued)**

**Stability Class E** | **Wind Speed (Knots)**

| **Direction** | **0.6 - 3.0** | **4 - 6** | **7 - 10** | **11-16** | **17 - 21** | **> 21** | **Row Total** |
|---|---|---|---|---|---|---|---|
| E | 0.00096 | 0.00250 | 0.00167 | | | | 0.00514 |
| ENE | 0.00055 | 0.00142 | 0.00044 | | | | 0.00241 |
| ESE | 0.00105 | 0.00328 | 0.00534 | | | | 0.00967 |
| N | 0.00052 | 0.00162 | 0.00122 | | | | 0.00337 |
| NE | 0.00042 | 0.00078 | 0.00027 | | | | 0.00147 |
| NNE | 0.00042 | 0.00088 | 0.00118 | | | | 0.00248 |
| NNW | 0.00088 | 0.00117 | 0.00112 | | | | 0.00317 |
| NW | 0.00101 | 0.00149 | 0.00148 | | | | 0.00398 |
| S | 0.00103 | 0.00167 | 0.00237 | | | | 0.00507 |
| SE | 0.00121 | 0.00289 | 0.00370 | | | | 0.00780 |
| SSE | 0.00100 | 0.00271 | 0.00276 | | | | 0.00647 |
| SSW | 0.00077 | 0.00150 | 0.00133 | | | | 0.00360 |
| SW | 0.00105 | 0.00095 | 0.00094 | | | | 0.00294 |
| W | 0.00267 | 0.00523 | 0.01179 | | | | 0.01969 |
| WNW | 0.00233 | 0.00315 | 0.00286 | | | | 0.00834 |
| WSW | 0.00129 | 0.00206 | 0.00359 | | | | 0.00695 |
| **Sum** | 0.01717 | 0.03332 | 0.04206 | | | | 0.09254 |

## Table 2.5-10 ACC Joint Frequency Distribution for 1997-2006 (Continued)

**Stability Class F** **Wind Speed (Knots)**

| Direction | 0.6 - 3.0 | 4 - 6 | 7 - 10 | 11-16 | 17 - 21 | > 21 | Row Total |
|---|---|---|---|---|---|---|---|
| E | 0.00363 | 0.00131 | | | | | 0.00493 |
| ENE | 0.00244 | 0.00081 | | | | | 0.00325 |
| ESE | 0.00372 | 0.00151 | | | | | 0.00524 |
| N | 0.00346 | 0.00110 | | | | | 0.00455 |
| NE | 0.00220 | 0.00071 | | | | | 0.00291 |
| NNE | 0.00250 | 0.00079 | | | | | 0.00330 |
| NNW | 0.00446 | 0.00125 | | | | | 0.00570 |
| NW | 0.00750 | 0.00138 | | | | | 0.00888 |
| S | 0.00509 | 0.00156 | | | | | 0.00665 |
| SE | 0.00458 | 0.00162 | | | | | 0.00620 |
| SSE | 0.00481 | 0.00151 | | | | | 0.00632 |
| SSW | 0.00479 | 0.00153 | | | | | 0.00631 |
| SW | 0.00581 | 0.00190 | | | | | 0.00772 |
| W | 0.01356 | 0.00380 | | | | | 0.01736 |
| WNW | 0.01183 | 0.00272 | | | | | 0.01455 |
| WSW | 0.00939 | 0.00253 | | | | | 0.01192 |
| **Sum** | 0.08976 | 0.02603 | | | | | 0.11579 |

### 2.5.4 References

Curtis, J. and K. Grimes, 2007: *Wyoming Climate Atlas.* Available: http://www.wrds.uwyo.edu/wrds/wsc/climateatlas/ [2007,May 2].

Martner, B.E.,1986: *Wyoming Climate Atlas.* University of Nebraska Press, Lincoln, NE.

National Climatic Data Center, 2007: *Surface Data, Monthly Extremes.* Available: http://gis.ncdc.noaa.gov/website/ims-cdo/extmo/viewer.htm?Box=-110.307738654357:41.4493000825986:-102.349767058746:45.2536595444503 [2006, July 13].

Western Region Climate Center, 2007: *Local Climate Data Summaries.* Available: http://www.wrcc.dri.edu/summary/lcd.html [2006, Jan 28].

## 2.6 GEOLOGY

To aid in the review of Sections 2.6-1 through 2.6-4 all tables and figures were placed in Addendum 2.6-A.

### 2.6.1 Regional Geology

The Powder River Basin extends over much of northeastern Wyoming and southeastern Montana, and consists of a large north-northwest trending asymmetric syncline. The basement axis lies along the western edge of the basin, and the present surface axis lies to the east of the basement axis. The basin is bounded by the Big Horn Mountains to the west, the Black Hills to the east, and the Hartville Uplift and Laramie Mountains to the south.

The Powder River Basin is filled with marine, non-marine, and continental sediments ranging in age from early Paleozoic through Cenozoic. Sediments reach a maximum thickness of about 18,000 feet in the deepest parts of the basin, and probably range from 16-17,000 feet thick in the permit area, due to its close proximity to the deepest part of the basin.

The southern part of the basin contains Lance, Fort Union, Wasatch and White River formation outcrops. The Upper Cretaceous Lance formation is the oldest of these units, and consists of 1,000 to 3,000 feet of thinly-bedded, brown to gray sands and shales. The upper part contains minor, dark carbonaceous shales and thin coal seams, indicating a changing depositional environment over time, which was in this case the gradual regression of a shallow inland sea.

The Paleocene Fort Union formation conformably overlies the Lance and consists of continental and shallow non-marine deposits in two members. The lower member consists of fine-grained, clay-rich, drab to pink sandstone, with minor claystone and coal. The sandstones were deposited as alluvial fans and braided stream channels during erosion of the uplifted Black Hills, Bighorn, and Laramie Mountains. The upper member consists of shale, clayey sandstone, fine-to-coarse-grained sandstone, and some extensive sub bituminous lignite beds. The total thickness of the Fort Union formation varies between 2,000 and 3,500 feet (Conoco 1980; Sharp et al., 1964).

The early Eocene Wasatch formation unconformably overlies the Fort Union formation around the margins of the basin. However, the two formations are conformable and gradational towards the basin center and permit area. The relative amount of coarse, permeable clastics increases near the top of Fort Union, and the overlying Wasatch formation contains numerous beds of sandstone which are sometimes correlatable over wide areas. Except in isolated areas of the Powder River Basin, the Wasatch-Fort Union contact is arbitrarily set at the top of the thicker coals or of some thick sequence of clays and silts. The top of the Roland coal is probably the boundary in the project area.

The Wasatch formation crops out at the surface in the permit area. The Wasatch is similar to the Fort Union, but also contains thick lenses of coarse, crossbedded, arkosic sands deposited in a high-energy fluvial environment. These sandstone horizons are the host rocks for several uranium deposits in the southern Powder River Basin. Within the permit area, mineralization is found in a 50-100 foot thick sandstone lens which extends over an area of several townships. On a regional scale, mineralization is localized and controlled by facies changes within this sandstone, including thinning of the sandstone unit, decrease in grain size, and increase in clay and organic material content. The Wasatch formation reaches a maximum thickness of about 1,600 feet (1,100 to 1,300 feet in the permit area) and dips northwestward from one degree to two and a half degrees in the southern part of the Powder River Basin (Conoco 1980; Sharp et al., 1964).

The Oligocene White River formation overlies the Wasatch formation and has been removed from most of the basin by erosion. Remnants of this unit crop out on the Pumpkin Buttes, located approximately eight miles to the north of the permit area, and at the extreme southern edge of the Basin (about 60 miles to the south). The White River consists of clayey sandstone, claystone, a boulder conglomerate and tuffaceous sediments which may be the primary source rock for uranium in the Moore Ranch area and the southern part of the basin as a whole (Conoco 1980; Sharp et al., 1964). The youngest sediments consist of Quaternary alluvial sands and gravels locally present in larger valleys. Quaternary eolian sands can also be found locally.

The Teapot and Parkman sandstones are approximately 8,500 to 9,000 feet below land surface in this area, and are the next hydrologically significant geologic units below the Fort Union sands. The water quality of three well samples from the Parkman sandstone in Johnson County (see Whitcomb, Cummings and McCullough, 1966) near the outcrop of this formation contained total dissolved solids from 1360 to 3060 mg/l. Water quality is normally poorer at greater distances from its outcrop area, making the use of these aquifers questionable in this area.

The Madison limestone and Tensleep sandstone are approximately 15,000 feet below the land surface and would produce the largest discharge rates from wells in this area. The Madison is known to flow at several thousand gallons per minute to the Midwest area (see Crist and Lowry, 1972), and the flows from the Tensleep sandstone in this area are in the hundreds of gpm. However, the water quality of the Madison and Tensleep in the Powder River Basin is poor. Therefore, even though the Madison and Tensleep aquifers produce large quantities of water, the quality would probably make those aquifers unusable. Only the Roland coal and the Wasatch formation will be discussed further, because the lower units will not be influenced by this project.

### 2.6.2 Site Geology

The site is situated in the southwestern part of the Powder River Basin approximately 12 miles east-northeast of the Tertiary Wasatch-Fort Union formation contact. The Wasatch formation, which is the surface geologic unit in this area, is part of the thick Powder River sedimentary series and consists of interbedded sandstones, siltstones, claystones and coals. (Seeland, 1976) found that the Wasatch sandstones were deposited in a fluvial paleo drainage system which flowed generally northward. These channel deposits are the host rocks for many uranium ore deposits.

The Wasatch sandstones are very light gray to buff, semi-consolidated and well-sorted, with grain sizes in individual beds ranging from very fine to very coarse. Graded bedding is common and individual beds vary in thickness from a few inches to several feet. The finer-grained rocks range from highly consolidated, medium gray siltstones to dark gray carbonaceous claystone. The top of the Roland is approximately 1,100 feet deep in this area. The dip of the top of the Roland coal is to the west-northwest at an average of one degree.

Conoco exploration nomenclature designated most sands above the Roland coal with decreasing numbers with depth. Figure 2.6-1 depicts the sand units relevant to this project. Cross sections from exploration logs were developed for the area to evaluate the aerial distribution of these sands. Figure 2.6-2 shows the locations of the five cross sections included in Figures 2.6-3 through Figure 2.6-7 (A-A' through E-E' respectively). A pervasive lignite bed just above the ore sand was used as a datum for the cross sections, since the available elevation data on historic logs is questionable.

The 40 and 50 sands are separated by 5 to 40 feet of shale or mudstone and extend aerially across the project area. The approximate thicknesses of the 40 and 50 sands are 80 and 90 feet, respectively. These two sands contain some coarse material in most areas and are considered significant aquifers. The 60 sand is approximately 100 feet thick and is continuous throughout the area. It is separated from the 50 sand by about 80 feet of shale or mudstone with some interspersed sandstone lenses. The 40, 50, and 60 sands are shown in cross sections C-C' and E-E'. They all contain trace amounts of mineralization in various locations within the project area, however these deposits are not considered economic at this time.

The 68 sand is separated from the 60 sand by 5 to 25 feet of shale or mudstone. It is the first sand below the 70 sand, which contains the economic ore deposits in the area, and is therefore referred to as the underlying 68 sand. Figure 2.6-8 is an isopach map of the underlying 68 sand. The sand ranges from 40 to 100 feet thick within the project area.

The 70 sand is the proposed ore production sand. It is laterally extensive and ranges from 40 to 120 feet thick. The dip is generally less than one degree toward the northwest. A one to 3 foot thick lignite exists normally a few feet above the top of the 70 sand and has been labeled by

Conoco as the E coal. The average dip of the E coal is one-half of one degree toward the northwest. The average depth to the ore zone is 180 feet (Conoco 1980; Sharp et al., 1964).

Figure 2.6-9 is an isopach map of the production 70 sand. In the vicinity of monitor well UMW-2 the sand thickens and coalesces with the underlying 68 sand. An isopach map of the underlying shale (Figure 2.6-10) illustrates the disappearance of this shale in a small area around UMW-2 and a slightly larger area just to the northeast of UMW-2 (see also cross sections A-A' and E-E'). The coalescence of the 68 and 70 sands is discussed in further detail in Section 2.7. Figures 2.6-11 and 2.6-12 are isopach maps of the overlying shale and the overlying 72 sand, respectively. The overlying shale ranges from a few feet to 160 feet thick (where the 72 sand pinches out), and typically includes the E coal. The overlying 72 sand is anywhere from 0 to 100 feet thick. The sand pinch-out on the west side of the project area can also be seen on cross sections A-A' and D-D'.

### 2.6.3 Mineralogy of the Uranium Ore

The ore-bearing unit (70 sand) is an arkosic sandstone with calcite and clays as the dominant cementing material. The mean size of the particles is about 0.3 millimeters and the slime content (-325 mesh) is 3 to 6 percent. The dominant clay is montmorillonite, approximately 50 percent, and the other clays, illite and kaolinite, each comprise about 25 percent of the total clay content. There are also trace amounts of chlorite present (Conoco, 1982).

The uranium is associated with either calcite or clay cement. Occasionally, the uranium is associated with woody lignite fragments. Very little crystalline uranium mineral can be identified except for the occasional presence of uranite. Heavy minerals include pyrite, magnetite, ilmenite, and garnet (almandine) (Conoco, 1982).

### 2.6.4 Drill Holes

The Moore Ranch Uranium Project was extensively explored from the 1970s through the mid-1980s with the principle exploratory work and drilling completed by Conoco Minerals Corporation. Approximately 2,700 rotary drill holes and approximately 130 core holes were completed by Conoco. The drilling included the delineation of 3 areas of mineralization as planned open pit mining operations with drilling on 50-foot centers. Mineral resource estimates are based on radiometric equivalent uranium grade as measured by the geophysical logs and verified by core drilling and chemical analysis. Drill holes completed by Conoco were reported plugged in accordance with Wyoming Statute WS 35-11-401 in effect at the time. According to WDEQ-LQD District III personnel, several holes required additional abandonment work, which was completed by Conoco.

EMC conducted verification drilling in late 2006 totaling 157 holes and 20 monitor wells. The drilling was conducted under WDEQ-LQD Drilling Notification 342DN and all drill holes were plugged in accordance with Wyoming Statute WS35-11-401 as documented.

Table 2.6-1 lists all drill holes known to EMC in the project area and Figure 2.6-13 is a map showing these known drill holes.

### 2.6.5 Soils

The Energy Metals Moore Ranch Unit was evaluated by BKS Environmental Associates, Inc., Gillette, Wyoming in 2007.

The following NRCS soil series have been renamed: Absted loam to Arvada (thick surface) loam, Fort Collins loam to Forkwood loam, Olney sandy loam to Hiland sandy loam, Tassel sandy loam to Taluce sandy loam, Terry sandy loam to Terro sandy loam, Stoneham loam to Cambria loam, and Thedalund loam to Theedle loam. A total of 7,104.1 acres were included in the final soil mapping of the Moore Ranch Unit. Soils mapped by BKS Environmental Associates, Inc. are illustrated on Figure 2.6-14.

Stripping depths for the Moore Ranch Unit were evaluated during mapping and sampling. Soil depths within a given mapping unit will vary based on any combination of the five primary soil forming factors, i.e., climate including effective precipitation, organisms, relief or topography, parent material, and time. Subtle differences in any one of the previously mentioned factors will impact development between series and within series designation but may not be as noticeable as when topography is a major factor. The proposed topsoil salvage depths for the Moore Ranch Unit are based on laboratory data of the samples found within the borders of the area, as well as field observations and knowledge of the soils in Southern Campbell County, Wyoming.

Soils in the Moore Ranch Unit are typical for semi-arid grasslands and shrublands in the Western United States. Parent material included colluvium, residuum, and alluvium. Most soils are classified taxonomically as Ustic Paleargids, Ustic Haplargids, Ustic Torriorthents, and Ustic Haplocambids.

Most soils have some suitable topsoil. The primary limiting chemical factor within the Moore Ranch Unit is likely Selenium. The primary limiting physical factor is texture.

Large scale soil surveys had been previously conducted, by the U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) in 1972 and 1991. The major objective of the 2007 assessment was to define the existing topsoil resource within the Moore Ranch Unit and determine the extent, availability, and suitability of soils material for use in reclamation. The mapping and reporting for the Moore Ranch Unit incorporated map unit information from the previous NRCS soil surveys. Soil sampling needs were determined from WDEQ Guideline 1 (August 1994 Revision).

Refer to Addendum 2.6-B for the Soil Mapping Unit Descriptions. Refer to Addendum 2.6-C for the Soil Series Descriptions. Refer to Addendum 2.6-D for the Original Laboratory Data Sheets. Refer to Addendum 2.6-E for the Prime Farmland Designation.

### 2.6.5.1 Methodology

Review of Existing Literature

The soils in this portion of Campbell County were studied and mapped to an Order 3 scale by the USDA, NRCS in 1972 and 1991. Information in Southern Campbell County is available electronically as well as hard copy. The NRCS has also centralized dissemination of typical soil series descriptions; information is available on the internet at www.nrcs.usda.gov.

Project Participants

BKS performed the 2007 soil survey field work and compiled the resulting report. All soil analysis was handled by Energy Labs. Samples were taken to Energy Labs in Gillette for shipment to Casper, Wyoming and ultimate analysis.

Soil Survey

Construction of the project area soil map was completed according to techniques and procedures of the National Cooperative Soil Survey. Guideline No. 1 (original November, 1984 and updated August, 1994) of the Wyoming Department of Environmental Quality, Land Quality Division (WDEQ-LQD) was followed during all phases of the work.

The following NRCS soil series have been renamed: Absted loam to Arvada (thick surface) loam, Fort Collins loam to Forkwood loam, Olney sandy loam to Hiland sandy loam, Tassel sandy loam to Taluce sandy loam, Terry sandy loam to Terro sandy loam, Stoneham loam to Cambria loam, and Thedalund loam to Theedle loam. A total of 7,104.1 acres were included in the final soil mapping of the Moore Ranch Unit.

Refer to Table 2.6-2 for soil mapping unit designations and associated acreage within the Moore Ranch Unit. Table 2.6-2 also describes the soil map units in terms of actual map designations and slope percentages.

Field Sampling

Soil series were sampled to reflect recommended sample numbers in WDEQ Guideline 1 (August 1994 Revision) based on preliminary mapping acreage identified at that time.

Series were sampled and described by coring with a mechanical auger, i.e., truck-mounted Giddings. The physical and chemical nature of each horizon within the sampled profile was described and recorded in the field. Although numerous holes were augured for series and map unit verification, only the field locations of profiles selected for laboratory analysis are plotted on the soils map included with this report. Sampled soil material was placed in clean, labeled, polyethylene plastic bags and kept cool to limit chemical changes. Samples were kept out of direct sunlight and transported to Energy Labs for analysis. A total of 20 sites on the Moore Ranch Unit were sampled for analysis; all had corresponding soil profile descriptions written. Refer to Table 2.6-3 Soils Series Sample Summary and Table 2.6-4 Soil Sample Locations.

Laboratory Analysis

Samples were individually placed into lined aluminum pans to air dry. Coarse fragments were measured with a 10 mesh screen prior to grinding; the entire sample was then hand ground to pass 10 mesh. An approximate 20 ounce subsample was obtained through splitting with a series of riffle splitters and subsequently analyzed. A second subsample was maintained in storage at Energy Labs. Approximately 10 percent of the samples are run for duplicate analysis. Actual laboratory analysis follows the methodology outlined in WDEQ-LQD Guideline 1 (August 1994 Revision). In general, samples were analyzed within 45 days of receipt of the samples at the laboratory. All analytical data is presented in Addendum 2.6-D, Original Laboratory Data Sheets.

2.6.5.2 Results and Discussion

Soil Survey - General

General topography of the area includes rolling hills and ridges, as well as drainages. The soils occurring on the Energy Metals Moore Ranch Unit were generally fine textured throughout with patches of sandy loam on upland areas and fine textured soils occurring near or in drainages. The project area contained deep soils on lower toe slopes and flat areas near drainages with shallow and moderately deep soils located on upland ridges and shoulder slopes.

Soil Mapping Unit Interpretation

The primary purpose of the 2007 fieldwork was to characterize the soils within the proposed project area in terms of topsoil salvage depths and related physical and chemical properties. The total number of samples per series was established in line with WDEQ Guideline 1 (August 1994 Revision) recommendations based on estimated acreage of soil series known within the Moore Ranch Unit Study Area which includes the ore body and proposed facilities. Refer to Addendum 2.6-B and 2.6-C for soil mapping unit descriptions and soil series descriptions, respectively.

Analytical Results

Analyzed parameters, as defined in WDEQ Guideline 1 (August 1994 Revision), are in Addendum 2.6-D, Original Laboratory Data Sheets. Laboratory soil texture analysis did not include percent fine sands. Field observations of fine sands within individual pedestals as well as sample site topographic position were used in conjunction with laboratory analytical results to determine series designation.

Evaluation of Soil Suitability as a Plant Growth Medium

Approximate salvage depths of each map unit series is presented in Table 2.6-6 and ranged from .8 to 5 feet. Within the Moore Ranch Project area, suitability of soil as a plant growth medium is generally affected by physical factors such as texture. Chemical limiting factors included selenium (Se), saturation percentage and, in one case, SAR. Marginal material, according to WDEQ Guideline 1, was found in 11 of the 20 profiles. No unsuitable material, according to WDEQ Guideline 1, was found in any of the profiles. Marginal or unsuitable parameter information for sampled profiles is identified in Table 2.6-5. Based on laboratory analysis and field observations marginal material parameters primarily consisted of texture and selenium (Se).

Topsoil Volume Calculations

Based on the 2006 fieldwork with associated field observations and subsequent chemical analysis, recommended topsoil average salvage depths over the proposed project boundary were determined to be 3.6 feet. Refer to Table 2.6-6, Approximate Soil Salvage Depths.

In accordance with WDEQ Guideline 4, the A (and E) horizons are to be salvaged from secondary access roads. As shown in Addendum 2.6-C, the typical A soil horizons for the mapping units contained on the Moore Ranch project range from 0-2 to 0-5 inches with a typical rang of 0-3 inches (no E horizons are shown). Since the primary access road is already constructed, only secondary roads to access wellfield facilities will be constructed for the Moore Ranch Project. It is estimated that approximately 2 miles of secondary roads will be constructed (typical width is 15 feet including borrow ditches) totaling approximately 2 acres. Assuming the typical 3 inches of topsoil is stripped, the approximate volume that will be salvaged for road construction 0.5 acre-ft.

The fenced controlled area containing the central plant, office building, shop, warehouse, parking lots, and other facilities is approximately 11 acres. In accordance with WDEQ Guideline 4, suitable topsoil shall be salvaged from permanent or long-term facilities areas. Assuming all 11 acres will be stripped for construction of these facilities, approximately 39.6 acre-ft of topsoil (at the average depth of 3.6 feet) may be salvaged and stockpiled (some portions of the 11-acre area may not contain facilities that require salvaging of topsoil, therefore the volume estimate is considered conservative). All long-term topsoil stockpiles will be constructed and maintained in accordance with WDEQ-LQD Rules and Regulations, Chapter 2.

Topsoil is not stripped from wellfield areas, and no other large structures such as tailings disposal ponds, evaporation ponds, or overburden piles will be constructed at the site that would require salvage of topsoil.

Soil Erosion Properties and Impacts

Based on the soil mapping unit descriptions, the hazard for wind and water erosion within the Moore Ranch Unit varies from slight to severe. The potential for wind and water erosion is mainly a factor of surface characteristics of the soil, including texture and organic matter content. Given the fine-loamy and sandy texture of the surface horizons throughout the majority of the Moore Ranch Unit, the soils are more susceptible to erosion from wind than water. See Table 2.6-7 for a summary of wind and water erosion hazards within the Moore Ranch Unit.

The 11 acre fenced controlled area is underlain by soils with a slight potential for water erosion and a severe potential for wind erosion. All topsoil will be stripped, stockpiled and maintained in accordance with WDEQ-LQD rules and regulations, the surface will be graded, and stormwater will be routed. These measures will help reduce the effect of construction on soil erosion.

The soils underlying the proposed wellfields are at a moderate to severe risk of erosion from both wind and water. Though no topsoil will be stripped from the wellfields, construction may result in an increase in the erosion hazard from both wind and water due to the removal of vegetation and the physical disturbance from heavy equipment. All areas are reseeded as soon as possible to keep the duration of bare soil to a minimum. Reseeding will help mitigate the increased erosion potential from the construction disturbance.

Prime Farmland Assessment

No prime farmland was indicated within the Moore Ranch Unit based on a reconnaissance survey by the NRCS. Refer to Addendum 2.6-E, Prime Farmland Designation, for the NRCS letter of negative determination.

## Table 2.6-2 Soil Mapping Unit Acreages for the Moore Ranch Unit

| Map Symbol | Map Unit Description | Permit Acreage | Study Area Acreage | % Total Study Area |
|---|---|---|---|---|
| 110 | Bidman loam, loamy substratum, 0 to 6 percent slopes | 1.81 | | |
| 144 | Forkwood loam, 0 to 6 percent slopes | 349.08 | 25.58 | 2.56 |
| 156 | Hiland fine sandy loam, 0 to 6 percent slopes | 297.58 | 156.14 | 15.63 |
| 226 | Ulm loam, 0 to 6 percent slopes | 211.59 | 39.87 | 3.99 |
| 227 | Ulm clay loam, 0 to 6 percent slopes | 26.69 | | |
| 235 | Vonalee fine sandy loam, 0 to 10 percent slopes | 216.75 | 30.08 | 3.01 |
| 111-1 | Bidman loam, 0 to 6 percent slopes | 108.97 | 31.5 | 3.15 |
| 111-2 | Parmleed loam, 0 to 6 percent slopes | 138.37 | | |
| 112-1 | Bidman loam, 6 to 15 percent slopes | 40.82 | | |
| 112-2 | Parmleed loam, 6 to 15 percent slopes | 170.57 | | |
| 116-1 | Cambria loam, 0 to 6 percent slopes | 61.82 | | |
| 116-2 | Kishona loam, 0 to 6 percent slopes | 193.13 | 8.79 | 0.88 |
| 116-3 | Zigweid loam, 0 to 6 percent slopes | 74.21 | 23.18 | 2.32 |
| 117-1 | Cambria loam, 6 to 15 percent slopes | 71.51 | | |
| 117-2 | Kishona loam, 6 to 20 percent slopes | 13.22 | | |
| 122-1 | Cushman loam, 6 to 15 percent slopes | 730.43 | 187.07 | 18.73 |
| 124-2 | Shingle loam, 3 to 30 percent slopes | 272.28 | 68.60 | 6.87 |
| 127-2 | Theedle loam, 0 to 30 percent slopes | 842.27 | 74.46 | 7.46 |
| 140-1 | Embry sandy loam, 3 to 20 percent slopes | 41.15 | | |
| 146-2 | Cushman loam, 0 to 6 percent slopes | 493.61 | 133.08 | 13.33 |
| 147-1 | Forkwood loam, 6 to 15 percent slopes | 90.39 | | |
| 153-1 | Haverdad clay loam, 0 to 6 percent slopes | 141.42 | | |
| 153-2 | Kishona clay loam, 0 to 6 percent slopes | 163.66 | | |
| 157-2 | Bowbac fine sandy loam, 0 to 6 percent slopes | 211.56 | 62.25 | 6.23 |
| 158-1 | Hiland fine sandy loam, 6 to 15 percent slopes | 825.73 | 97.56 | 9.77 |
| 158-2 | Bowbac fine sandy loam, 6 to 15 percent slopes | 493.10 | 35.33 | 3.54 |
| 170-2 | Tullock loamy sand, 6 to 30 percent slopes | 8.49 | | |
| 171-1 | Keeline, dry complex, 3 to 30 percent slopes | 106.75 | 19.52 | 1.95 |
| 194-1 | Pugsley sandy loams, 6 to 15 percent slopes | 53.65 | | |
| 194-2 | Decolney sandy loams, 6 to 15 percent slopes | 12.99 | | |
| 205-1 | Samday clay loam, 3 to 15 percent slopes | 14.03 | | |
| 213-1 | Terro sandy loam, 6 to 30 percent slopes | 142.49 | | |
| 216-2 | Kishona loam, 6 to 30 percent slopes | 261.53 | | |
| 221-1 | Turnercrest fine sandy loam, 6 to 30 percent slopes | 168.96 | | |
| 221-3 | Taluce fine sandy loam, 6 to 30 percent slopes | 22.55 | 5.66 | 0.57 |
| 228-2 | Renohill clay loam, 0 to 6 percent slopes | 5.29 | | |
| 236-2 | Terro fine sandy loam, 2 to 10 percent slopes | 25.65 | | |
| **Total** | | **7,104.1** | **998.67** | **100.00** |

## Table 2.6-3. Soil Series Sample Summary for the Moore Ranch Unit Study Area[1]

| Soil Series | Number of Profiles to be Sampled for Chemical Analysis |
|---|---|
| Forkwood | 1 |
| Hiland | 3 |
| Ulm | 1 |
| Ulm clay | 0 |
| Vonalee | 1 |
| Bidman | 1 |
| Parmleed | 0 |
| Cambria | 0 |
| Kishona | 1 |
| Zigweid | 1 |
| Cushman | 3 |
| Shingle | 2 |
| Theedle | 2 |
| Embry | 0 |
| Haverdad | 0 |
| Bowbac | 2 |
| Tullock | 0 |
| Keeline | 1 |
| Renohill | 0 |
| Pugsley | 0 |
| Decolney | 0 |
| Samday (Samsil) | 0 |
| Terro | 0 |
| Taluce | 1 |
| Turnercrest | 0 |
| **Total** | **20** |

[1]Based on the proposed disturbed area as defined by initial estimates of the ore body, facilities and major roads.

**Table 2.6-4. Soil Sample Locations for the Moore Ranch Unit Study Area**

| Soil Sample Number | Map Unit Designation | Soils Series |
|---|---|---|
| 14-1 | 156 Hiland fine sandy loam, 0 to 6 percent slopes | Hiland |
| 19-1 | 156 Hiland fine sandy loam, 0 to 6 percent slopes | Hiland |
| 33-1 | 171-1 Keeline, dry complex | Keeline |
| 36-1 | 122-1 Cushman loam, 6 to 15 percent slopes | Cushman |
| 37-1 | 146-2 Cushman loam, 0 to 6 percent slopes | Cushman |
| 80-1 | 158-2 Bowbac fine sandy loam, 6 to 15 percent slopes | Bowbac |
| 107-1 | 124-2 Shingle loam, 3 to 30 percent slopes | Shingle |
| 108-1 | 116-2 Kishona loam, 0 to 6 percent slopes | Kishona |
| 116-1 | 157-2 Bowbac fine sandy loam, 0 to 6 percent slopes | Bowbac |
| 117-1 | 226 Ulm loam, 0 to 6 percent slopes | Ulm |
| 123-1 | 116-3 Zigweid loam, 0 to 6 percent slopes | Zigweid |
| 126-1 | 221-3 Taluce fine sandy loam, 6 to 30 percent slopes | Taluce |
| 127-1 | 144 Forkwood loam 0 to 6 percent slopes | Forkwood |
| 300 | Bidman loam, 0 to 6 percent slopes | Bidman |
| 301 | 235 Vonalee loam 0 to 6 percent slopes | Vonalee |
| 302 | 158-1 Hiland fine sandy loam, 6 to15 percent slopes | Hiland |
| 303 | 124-2 Shingle loam, 3 to 30 percent slopes | Shingle |
| 304 | 127-2 Theedle loam, 0 to 30 percent slopes | Theedle |
| 305 | 146-2 Cushman loam, 0 to 6 percent slopes | Cushman |
| 306 | 127-2 Theedle loam, 0 to 30 percent slopes | Theedle |

**Table 2.6-5. Summary of Marginal and Unsuitable Parameters within the Sampled Profiles for the Moore Ranch Unit**

| Series | Sample Point | Depth (in) | Parameter |
|---|---|---|---|
| Hiland | 19-1 | 24-32 | Marginal texture |
| Hiland | 19-1 | 32-44 | Marginal texture |
| Hiland | 19-1 | 44-60 | Marginal SAR and marginal selenium |
| Cushman | 36-1 | 3-12 | Marginal texture |
| Cushman | 36-1 | 12-17 | Marginal texture |
| Cushman | 36-1 | 17-36 | Marginal texture |
| Cushman | 36-1 | 36-42 | Marginal texture |
| Cushman | 37-1 | 7-15 | Marginal texture and marginal coarse fragments |
| Cushman | 37-1 | 15-18 | Marginal saturation percentage and marginal texture |
| Cushman | 37-1 | 18-28 | Marginal saturation percentage and marginal texture |
| Kishona | 108-1 | 24-30 | Marginal texture |
| Kishona | 108-1 | 30-44 | Marginal texture |
| Ulm | 117-1 | 10-21 | Marginal texture |
| Ulm | 117-1 | 21-32 | Marginal texture |
| Zigweid | 123-1 | 32-44 | Marginal selenium |
| Zigweid | 123-1 | 44-54 | Marginal selenium |
| Zigweid | 123-1 | 54-60 | Marginal selenium |
| Forkwood | 127-1 | 27-45 | Marginal texture |
| Bidman | 300 | 4-20 | Marginal texture |
| Bidman | 300 | 20-28 | Marginal texture |
| Bidman | 300 | 28-40 | Marginal texture |
| Vonalee | 301 | 0-2 | Marginal saturation percentage |
| Theedle | 304 | 0-3 | Marginal texture |
| Theedle | 306 | 2-20 | Marginal texture |

## Table 2.6-6 Summary of Approximate Soil Salvage Depths Within the Moore Ranch Study Area

| Map Symbol | Mapping Unit Description | Moore Ranch Unit Study Area | Salvage Depth (feet) | Total Volume (Acre feet) |
|---|---|---|---|---|
| 144 | Forkwood loam, 0 to 6 percent slopes | 25.58 | 5.0 | 127.9 |
| 156 | Hiland fine sandy loam, 0 to 6 percent slopes | 156.14 | 4.5 | 702.63 |
| 226 | Ulm loam, 0 to 6 percent slopes | 39.87 | 4.2 | 167.45 |
| 235 | Vonalee fine sandy loam, 0 to 10 percent slopes | 30.08 | 5 | 150.4 |
| 111-1 | Bidman loam, 0 to 6 percent slopes | 31.5 | 4.2 | 132.3 |
| 116-2 | Kishona loam, 0 to 6 percent slopes | 8.79 | 5.0 | 43.95 |
| 116-3 | Zigweid loam, 0 to 6 percent slopes | 23.18 | 3.7 | 85.76 |
| 122-1 | Cushman loam, 6 to 15 percent slopes | 187.07 | 2.7 | 505.09 |
| 124-2 | Shingle loam, 3 to 30 percent slopes | 68.60 | 0.8 | 54.88 |
| 127-2 | Theedle loam, 6 to 15 percent slopes | 74.46 | 1.7 | 126.58 |
| 146-2 | Cushman loam, 0 to 6 percent slopes | 133.08 | 2.7 | 359.31 |
| 157-2 | Bowbac fine sandy loam, 0 to 6 percent slopes | 62.25 | 3.0 | 186.75 |
| 158-1 | Hiland fine sandy loam, 6 to 15 percent slopes | 97.56 | 4.5 | 439.02 |
| 158-2 | Bowbac fine sandy loam, 6 to 15 percent slopes | 35.33 | 5.0 | 176.65 |
| 171-1 | Keeline, dry complex, 3 to 30 percent slopes | 19.52 | 5.0 | 97.6 |
| 221-3 | Taluce fine sandy loam, 6 to 30 percent slopes | 5.66 | 0.8 | 4.53 |
| **Average Salvage Depth of Study Area** | | | **3.6** | |
| **Total** | | **998.67** | | **3360.8** |

## Table 2.6-7 Summary of Wind and Water Erosion Hazards[1] Within the Moore Ranch Unit

| Map Symbol | Map Unit Description | Water Erosion Hazard | Wind Erosion Hazard |
|---|---|---|---|
| 110 | Bidman loam, loamy substratum, 0 to 6 percent slopes | Slight | Moderate |
| 144 | Forkwood loam, 0 to 6 percent slopes | Slight | Moderate |
| 156 | Hiland fine sandy loam, 0 to 6 percent slopes | Slight | Severe |
| 226 | Ulm loam, 0 to 6 percent slopes | Slight | Moderate |
| 227 | Ulm clay loam, 0 to 6 percent slopes | Slight | Moderate |
| 235 | Vonalee fine sandy loam, 0 to 10 percent slopes | Moderate | Severe |
| 111-1 | Bidman loam, 0 to 6 percent slopes | Slight | Moderate |
| 111-2 | Parmleed loam, 0 to 6 percent slopes | Slight | Moderate |
| 112-1 | Bidman loam, 6 to 15 percent slopes | Slight | Moderate |
| 112-2 | Parmleed loam, 6 to 15 percent slopes | Slight | Moderate |
| 116-1 | Cambria loam, 0 to 6 percent slopes | Slight | Moderate |
| 116-2 | Kishona loam, 0 to 6 percent slopes | Slight | Moderate |
| 116-3 | Zigweid loam, 0 to 6 percent slopes | Slight | Moderate |
| 117-1 | Cambria loam, 6 to 15 percent slopes | Slight | Moderate |
| 117-2 | Kishona loam, 6 to 20 percent slopes | Severe | Moderate |
| 122-1 | Cushman loam, 6 to 15 percent slopes | Severe | Moderate |
| 124-2 | Shingle loam, 3 to 30 percent slopes | Severe | Moderate |
| 127-2 | Theedle loam, 0 to 30 percent slopes | Severe | Moderate |
| 140-1 | Embry sandy loam, 3 to 20 percent slopes | Moderate | Severe |
| 146-2 | Cushman loam, 0 to 6 percent slopes | Severe | Moderate |
| 147-1 | Forkwood loam, 6 to 15 percent slopes | Slight | Moderate |
| 153-1 | Haverdad clay loam, 0 to 6 percent slopes | Slight | Moderate |
| 153-2 | Kishona clay loam, 0 to 6 percent slopes | Slight | Moderate |
| 157-2 | Bowbac fine sandy loam, 0 to 6 percent slopes | Slight | Severe |
| 158-1 | Hiland fine sandy loam, 6 to 15 percent slopes | Slight | Severe |
| 158-2 | Bowbac fine sandy loam, 6 to 15 percent slopes | Slight | Severe |
| 170-2 | Tullock loamy sand, 6 to 30 percent slopes | Slight | Severe |
| 171-1 | Keeline, dry complex, 3 to 30 percent slopes | Moderate | Severe |
| 194-1 | Pugsley sandy loams, 6 to 15 percent slopes | Severe | Severe |
| 194-2 | Decolney sandy loams, 6 to 15 percent slopes | Severe | Severe |
| 205-1 | Samday clay loam, 3 to 15 percent slopes | Severe | Moderate |
| 213-1 | Terro sandy loam, 6 to 30 percent slopes | Severe | Severe |
| 216-2 | Kishona loam, 6 to 30 percent slopes | Severe | Severe |
| 221-1 | Turnercrest fine sandy loam, 6 to 30 percent slopes | Severe | Severe |
| 221-3 | Taluce fine sandy loam, 6 to 30 percent slopes | Severe | Severe |
| 228-2 | Renohill clay loam, 0 to 6 percent slopes | Moderate | Moderate |
| 236-2 | Terro fine sandy loam, 2 to 10 percent slopes | Moderate | Severe |

[1]Based on soil mapping unit descriptions.

## 2.6.6 Seismology

### 2.6.6.1 Historic Seismicity

Historic seismic events for Campbell County and other counties surrounding the Moore Ranch Project area including Natrona, Converse, and Johnson Counties are summarized below.

Campbell County

Five magnitude 2.5 and greater earthquakes have been recorded in Campbell County. The first earthquake recorded in the county occurred on May 11, 1967. This magnitude 4.8 earthquake was centered in southwestern Campbell County approximately 7 miles west-northwest of Pine Tree Junction. The second event took place on February 18, 1972, when a magnitude 4.3 earthquake occurred approximately 18 miles east of Gillette. No damage was reported for either event.

Two earthquakes were recorded in Campbell County during the 1980s. On May 29, 1984, a magnitude 5.0, intensity V earthquake occurred approximately 24 miles west-southwest of Gillette. The earthquake was felt in Gillette, Sheridan, Buffalo, Casper, Douglas, Thermopolis, and Sundance. On October 29, 1984, a magnitude 2.5 earthquake occurred approximately 25 miles west-northwest of Gillette. No damage was reported.

Most recently, on February 24, 1993, a magnitude 3.6 earthquake occurred in southeastern Campbell County approximately 10 miles east-southeast of Reno Junction. No damage was reported.

Natrona County

Twelve magnitude 2.5 or intensity III and greater earthquakes have been recorded in Natrona County. The first earthquake that occurred in Natrona County took place on December 10, 1873, approximately 2 miles south of Powder River. People in the area reported feeling the earthquake as an intensity III event. Two of the earliest recorded earthquakes in Wyoming occurred near Casper. On June 25, 1894, an estimated intensity V earthquake was reported approximately 3 miles southwest of Evansville. Residents on Casper Mountain reported that dishes rattled to the floor and people were thrown from their beds. Water in the Platte River changed from fairly clear to reddish, and became thick with mud due to the riverbanks slumping into the river during the earthquake (Mokler, 1923). An even larger earthquake was felt in the same area on November 14, 1897. This intensity VI-VII earthquake, one of the largest recorded in central and eastern Wyoming caused considerable damage to a few buildings. On October 25, 1922, an intensity IV-V earthquake was detected approximately 6 miles north northeast of Barr

Nunn. The event was felt in Casper; at Salt Creek, 50 miles north of Casper; and at Bucknum, 22 miles west of Casper. No significant damage was reported at Casper.

One of the first earthquakes recorded near Midwest occurred on December 11, 1942. The intensity IV-V event occurred approximately 14 miles south of Midwest. Although no damage was reported, the event was felt in Casper, Salt Creek, and Glenrock. On August 27, 1948, another intensity IV earthquake was detected approximately 6 miles north-northeast of Bar Nunn. No damage was reported.

In the 1950's, two earthquakes caused some concern among Casper residents. On January 23, 1954, an intensity IV earthquake occurred approximately 7 miles northeast of Alcova. No damage was reported. On August 19, 1959, an intensity IV earthquake was recorded north of Casper, approximately 6 miles north-northeast of Bar Nunn. People in Casper reported feeling this event however it is uncertain if this earthquake actually occurred in the Casper area, as it coincides with the Hebgen Lake, Montana, earthquakes that initiated on August 17, 1959.

Only one earthquake was reported in Natrona County in the 1960s. On January 8, 1968, a magnitude 3.8 earthquake occurred approximately 10 miles north-northwest of Alcova. No damage was reported.

An earthquake of no specific magnitude or intensity occurred approximately 13 miles southeast of Ervay on June 16, 1973. No one felt this earthquake and no damage was reported.

No other earthquakes occurred in Natrona County until March 9, 1993, when a magnitude 3.2 earthquake was recorded 17 miles west of Midwest. No damage was reported. A magnitude 3.1 earthquake also occurred in the far northwestern corner of the county on November 9, 1999. No one reported feeling this earthquake that was centered approximately 32 miles northwest of Waltman.

Most recently, on February 1, 2003, a magnitude 3.7 earthquake occurred approximately 16 miles north-northeast of Casper. Numerous Casper residents felt this event.

Converse County

Twelve magnitude 3.0 and greater earthquakes have been recorded in Converse County. These earthquakes are discussed below. The first earthquake recorded in Converse County occurred on April 14, 1947. The earthquake had an intensity of V, and was felt near LaPrele Creek southwest of Douglas.

On August 21, 1952, an intensity IV earthquake occurred approximately 7 miles north-northeast of Esterbrook, in Converse County. It was felt by several people in the area, and was reportedly felt 40 miles to the southwest of Esterbrook. Three additional earthquakes have occurred in the same location as the August 21, 1952 event. The first, a small magnitude event with no associated magnitude or intensity, occurred on September 2, 1952. The second, an intensity III event, occurred on January 5, 1957. The most recent, an intensity IV event occurred on March 31, 1964. No damage was reported for any of the events.

On January 15, 1978, a magnitude 3.0, intensity III earthquake occurred approximately 3 miles northeast of Esterbrook, in Converse County. No damage was reported.

Two earthquakes occurred in Converse County in the 1980's. On November 15, 1983, a magnitude 3.0, intensity III earthquake occurred approximately 15 miles northeast of Casper in western Converse County. No damage was reported. On December 5, 1984, a non-damaging magnitude 2.9 earthquake occurred in the Laramie Range in southern Converse County.

Four earthquakes occurred in Converse County in the 1990's. On June 30, 1993, a magnitude 3.0 earthquake was located approximately 15 miles north of Douglas. No damage was reported. On July 23, 1993, a magnitude 3.7, intensity IV earthquake occurred in southern Converse County, approximately 13 miles north-northwest of Toltec in northern Albany County. This event was felt as far away as Laramie. On December 13, 1993, another earthquake occurred approximately 8 miles east of Toltec. This non-damaging event had a magnitude of 3.5. Most recently, on October 19, 1996, a magnitude 4.2 earthquake was recorded approximately 15 miles northeast of Casper in western Converse County. No damage was reported, although the event was felt by many Casper residents.

Johnson County

Eight magnitude 2.5 and greater earthquakes have been recorded in Johnson County. The first earthquake recorded in the county occurred on October 24, 1922. The location was originally determined to be near Buffalo, and classified the event as an intensity II earthquake. Based upon a description of the earthquake in the October 27, 1922 edition of the Sheridan Post, however, the location and assigned intensity may be in error. The Sheridan Post reported that at Cat Creek, 8 miles east of Sheridan, houses were shaken and dishes were rattled. In addition, the October 26, 1922 edition of the Sheridan Post reports that only a slight earthquake shock was felt in Sheridan. Based upon this information, it seems reasonable to locate the earthquake 8 miles east of Sheridan, and to assign an intensity of IV-V to the event.

On September 6, 1943, an intensity IV earthquake was felt in the Sheridan area, although the epicenter was determined to be approximately 3-4 miles south-southwest of Buffalo. Beds and chairs were reported "to sway" in the Sheridan area.

Two earthquakes were recorded in Johnson County in the 1960s. A magnitude 4.7 earthquake occurred on June 3, 1965. This event was centered approximately 12 miles south of Kaycee. On April 12, 1966, an earthquake of no specified magnitude or intensity was detected approximately 25 miles southwest of Buffalo. No one reported feeling these events.

On September 2, 1976, a magnitude 4.8, intensity IV-V earthquake was felt in Kaycee. The event was located approximately 33 miles northeast of Kaycee. No damage was reported.

A magnitude 5.1, intensity V earthquake occurred on September 7, 1984, approximately 33 miles east-southeast of Buffalo. The earthquake was felt throughout northeastern Wyoming, including Buffalo, Casper, Kaycee, Linch, and Midwest, and in parts of southeastern Montana. No significant damage was reported.

Two earthquakes were detected in Johnson County in 1992. The first occurred on February 22, 1992. This magnitude 2.9 event was recorded approximately 18 miles east of Buffalo. As expected with such a small earthquake, no damage was reported. Most recently, a magnitude 3.6, intensity IV earthquake occurred on August 30, 1992. The earthquake was centered near Mayoworth, approximately 22 miles west-northwest of Kaycee. It was felt in Barnum and Kaycee, but no damage was reported.

2.6.6.2 Deterministic Analysis of Regional Active Faults with a Surficial Expression

There are no known exposed active faults with a surficial expression in Campbell County. As a result, no fault-specific analysis can be generated for Campbell County.

2.6.6.3 Floating or Random Earthquake Sources

Many federal regulations require an analysis of the earthquake potential in areas where active faults are not exposed, and where earthquakes are tied to buried faults with no surface expression. Regions with a uniform potential for the occurrence of such earthquakes are called tectonic provinces. Within a tectonic province, earthquakes associated with buried faults are assumed to occur randomly, and as a result can theoretically occur anywhere within that area of uniform earthquake potential. In reality, that random distribution may not be the case, as all earthquakes are associated with specific faults. If all buried faults have not been identified, however, the distribution has to be considered random. "Floating earthquakes" are earthquakes that are considered to occur randomly in a tectonic province.

It is difficult to accurately define tectonic provinces when there is a limited historic earthquake record. When there are no nearby seismic stations that can detect small-magnitude earthquakes, which occur more frequently than larger events, the problem is compounded. Under these conditions, it is common to delineate larger, rather than smaller, tectonic provinces.

The U.S. Geological Survey identified tectonic provinces in a report titled "Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States" (Algermissen and others, 1982). In that report, Campbell County was classified as being in a tectonic province with a "floating earthquake" maximum magnitude of 6.1. Geomatrix (1988b) suggested using a more extensive regional tectonic province, called the "Wyoming Foreland Structural Province", which is approximately defined by the Idaho-Wyoming Thrust Belt on the west, 104° West longitude on the east, 40° North latitude on the south, and 45° North latitude on the north. Geomatrix (1988b) estimated that the largest "floating" earthquake in the "Wyoming Foreland Structural Province" would have a magnitude in the 6.0 – 6.5 range, with an average value of magnitude 6.25.

Federal or state regulations usually specify if a "floating earthquake" or tectonic province analysis is required for a facility. Usually, those regulations also specify at what distance a floating earthquake is to be placed from a facility. For example, for uranium mill tailings sites, the Nuclear Regulatory Commission requires that a floating earthquake be placed 15 kilometers from the site. That earthquake is then used to determine what horizontal accelerations may occur at the site. A magnitude 6.25 "floating" earthquake, placed 15 kilometers from any structure in Campbell County, would generate horizontal accelerations of approximately 15%g at the site. Critical facilities, such as dams, usually require a more detailed probabilistic analysis of random earthquakes. Based upon probabilistic analyses of random earthquakes in an area distant from exposed active faults (Geomatrix, 1988b), however, placing a magnitude 6.25 earthquake at 15 kilometers from a site will provide a fairly reasonable estimate of design ground accelerations in the northeastern and eastern parts of Campbell County, but will be inadequate in the southwestern part of the county.

#### 2.6.6.4 Probabilistic Seismic Hazard Analyses

The U.S. Geological Survey (USGS) publishes probabilistic acceleration maps for 500-, 1000- and 2,500-year time frames. The maps show what accelerations may be met or exceeded in those time frames by expressing the probability that the accelerations will be met or exceeded in a shorter time frame. For example, a 10% probability that acceleration may be met or exceeded in 50 years is roughly equivalent to a 100% probability of exceedance in 500 years.

The USGS has recently generated new probabilistic acceleration maps for Wyoming (Case, 2000). Copies of the 500-year (10% probability of exceedance in 50 years), 1000-year (5% probability of exceedance in 50 years), and 2,500-year (2% probability of exceedance in 50 years) maps are attached. Until recently, the 500-year map was often used for planning purposes for average structures, and was the basis of the most current Uniform Building Code. Recently, the UBC has been replaced by the International

Building Code (IBC), which is based upon probabilistic analyses. Campbell County adopted the IBC in 2005. The new International Building Code, however, uses a 2,500-year map as the basis for building design. The maps reflect current perceptions on seismicity in Wyoming. In many areas of Wyoming, ground accelerations shown on the USGS maps can be increased due to local soil conditions. For example, if fairly soft, saturated sediments are present at the surface, and seismic waves are passed through them, surface ground accelerations will usually be greater than would be experienced if only bedrock was present. In this case, the ground accelerations shown on the USGS maps would underestimate the local hazard, as they are based upon accelerations that would be expected if firm soil or rock were present at the surface. Intensity values and descriptions can be found in Table 2.6-8 and 2.6-9.

Based upon the 500-year map (10% probability of exceedance in 50 years) (Figure 2.6-15), the estimated peak horizontal acceleration in Campbell County ranges from approximately 3%g in the northeastern corner of the county to greater than 6%g in the southwestern corner of the county. These accelerations are roughly comparable to intensity IV earthquakes (1.4%g – 3.9%g) to intensity V earthquakes (3.9%g – 9.2%g). These accelerations are comparable to the accelerations to be expected in Seismic Zones 0 and 1 of the Uniform Building Code. Intensity IV earthquakes cause little damage. Intensity V earthquakes can result in cracked plaster and broken dishes. Gillette would be subjected to an acceleration of approximately 5%g or intensity V.

Based upon the 1000-year map (5% probability of exceedance in 50 years) (Figure 2.6-16), the estimated peak horizontal acceleration in Campbell County ranges from 4%g in the northeastern corner of the county to greater than 10%g in the southwestern quarter of the county. These accelerations are roughly comparable to intensity V earthquakes (3.9%g – 9.2%g) to intensity VI earthquakes (9.2%g – 18%g). Intensity V earthquakes can result in cracked plaster and broken dishes. Intensity VI earthquakes can result in fallen plaster and damaged chimneys. Depending upon local ground conditions, Gillette would be subjected to an acceleration of approximately 9%g or greater and intensity V or VI.

Based upon the 2500-year map (2% probability of exceedance in 50 years) (Figure 2.6-17), the estimated peak horizontal acceleration in Campbell County ranges from 8%g in the northeastern corner of the county to greater than 20%g in the southwestern corner of the county. These accelerations are roughly comparable to intensity V earthquakes (3.9%g – 9.2%g), intensity VI earthquakes (9.2%g – 18%g), and intensity VII earthquakes (18%g – 34%g). Intensity V earthquakes can result in cracked plaster and broken dishes. Intensity VI earthquakes can result in fallen plaster and damaged chimneys. Intensity VII earthquakes can result in slight to moderate damage in well-built ordinary structures, and considerable damage in poorly built or badly designed structures, such as unreinforced masonry. Chimneys may be broken. Gillette would be subjected to an acceleration of approximately 18%g or intensity VI to VII.

As the historic record is limited, it is nearly impossible to determine when a 2,500-year event last occurred in the county. Because of the uncertainty involved, and based upon the fact that the new International Building Code utilizes 2,500-year events for building design, it is suggested that the 2,500-year probabilistic maps be used for Campbell County analyses. This conservative approach is in the interest of public safety.

**Table 2.6-8: Modified Mercalli Intensity and Peak Ground Acceleration**

| Modified Mercalli Intensity | Acceleration (%g) (PGA) | Perceived Shaking | Potential Damage |
|---|---|---|---|
| **I** | <0.17 | Not felt | None |
| **II** | 0.17 – 1.4 | Weak | None |
| **III** | 0.17 – 1.4 | Weak | None |
| **IV** | 1.4 – 3.9 | Light | None |
| **V** | 3.9 – 9.2 | Moderate | Very Light |
| **VI** | 9.2 – 18 | Strong | Light |
| **VII** | 18 – 34 | Very Strong | Moderate |
| **VIII** | 34 – 65 | Severe | Moderate to Heavy |
| **IX** | 65 – 124 | Violent | Heavy |
| **X** | >124 | Extreme | Very Heavy |
| **XI** | >124 | Extreme | Very Heavy |
| **XII** | >124 | Extreme | Very Heavy |

**Table 2.6-9 Abridged Modified Mercalli Intensity Scale**

**Intensity value and description:**

**I** Not felt except by a very few under especially favorable circumstances.

**II** Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

**III** Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibration like passing of truck. Duration estimated.

**IV** During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing automobiles rocked noticeably.

**V** Felt by nearly everyone, many awakened. Some dishes, windows, and so on broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.

**VI** Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight.

**VII** Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.

**VIII** Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving cars disturbed.

**IX** Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

**X** Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.

**XI** Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

**XII** Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into the air.

**Figure 2.6-15. 500-year probabilistic acceleration map, 10% probability of exceedance in 50 years (Wyoming State Geological Survey, 2002).**

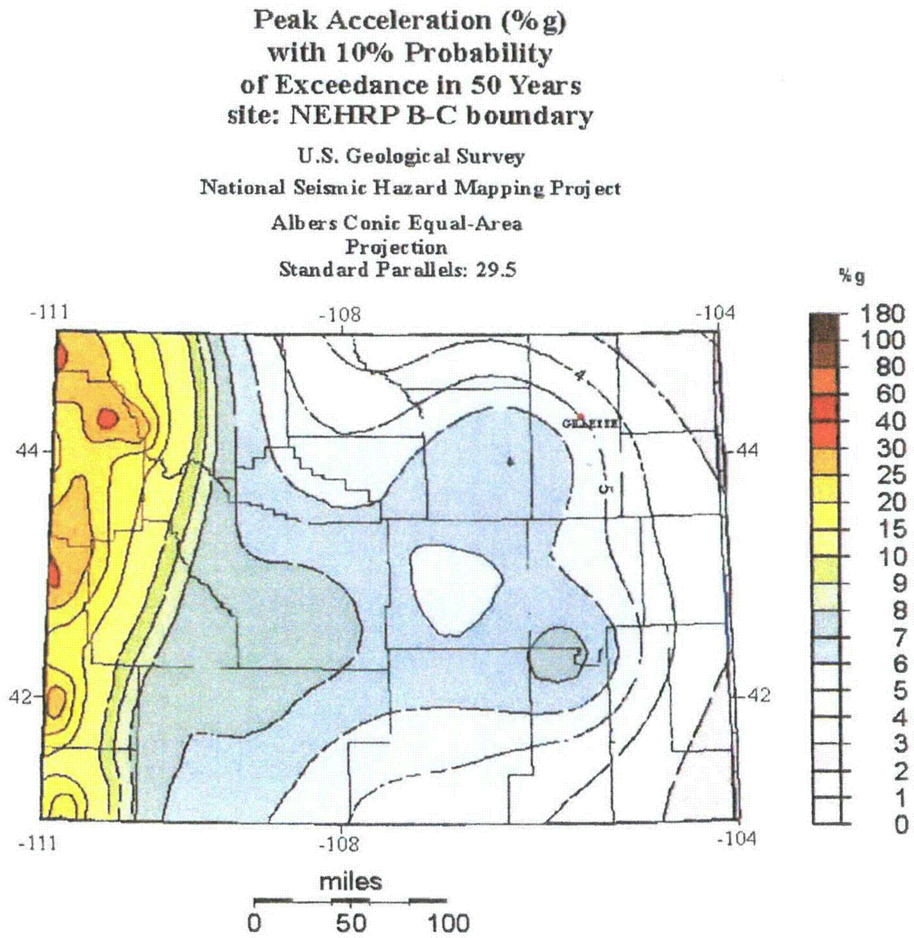


**Figure 2.6-16. 1000-year probabilistic acceleration map, 5% probability of exceedance in 50 years (Wyoming State Geological Survey, 2002).**

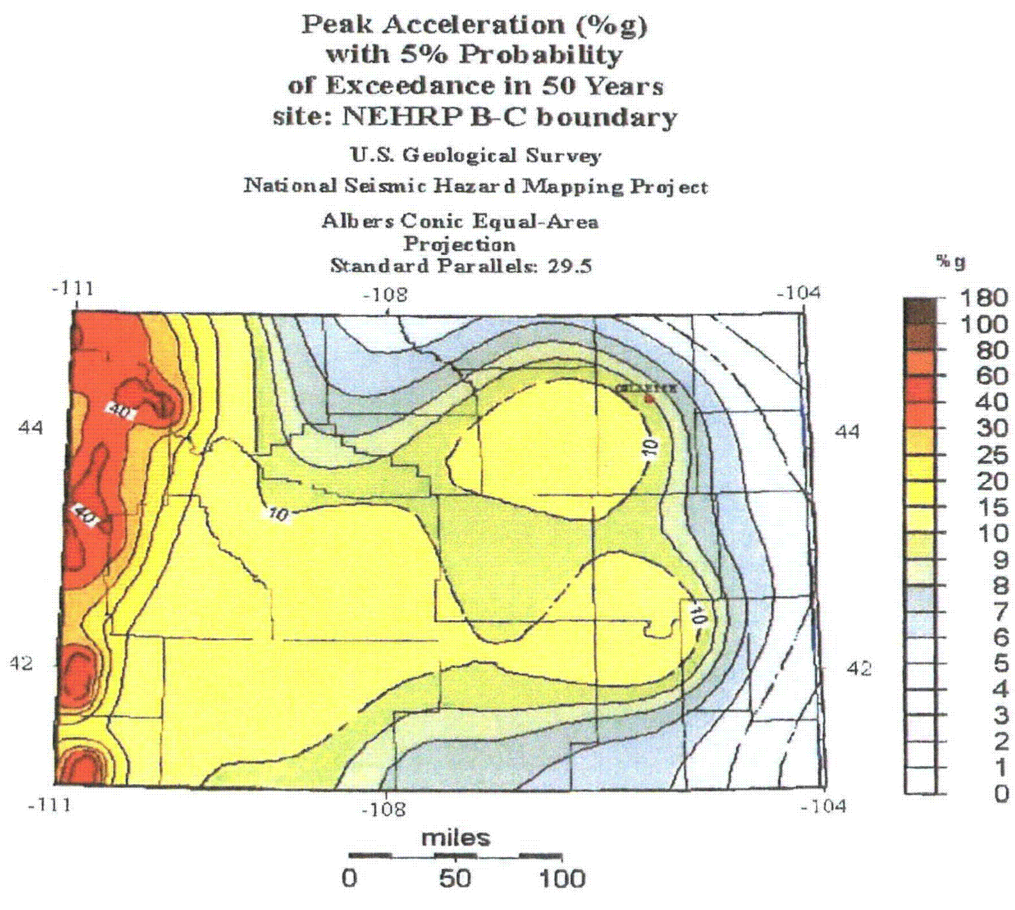
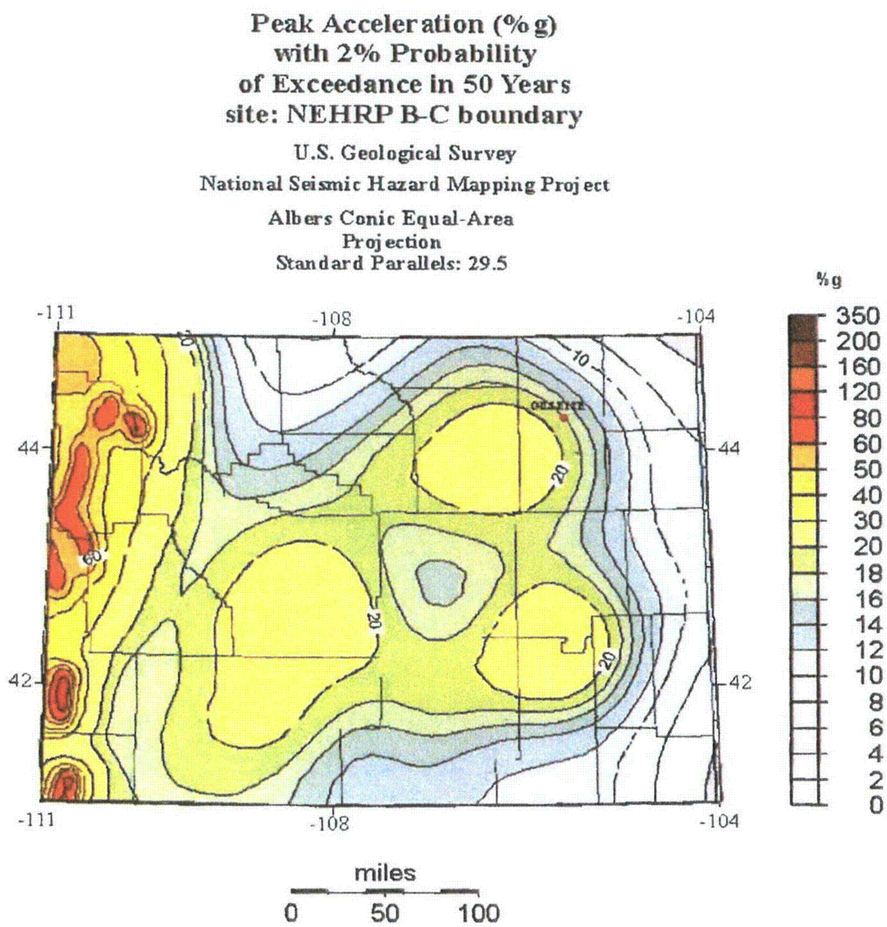


**Figure 2.6-17. 2500-year probabilistic acceleration map, 2% probability of exceedance in 50 years (Wyoming State Geological Survey, 2002).**



Current earthquake probability maps that are used in the newest building codes (2500 year maps) suggest a scenario that would result in moderate damage to buildings and their contents, with damage increasing from the northeast to the southwest. More specifically, the probability-based worst-case scenario could result in the following damage at points throughout Campbell and surrounding Counties:

Intensity VII Earthquake Areas

Gillette
Savageton
Wright
Casper
Edgerton
Midwest
Bar Nunn
Mills
Evansville
Hiland
Ervay
Barnum
Buffalo
Kaycee
Linch
Mayoworth
Sussex
Boxelder
Douglas
Glenrock
Orin
Orpha
Rolling Hills

In intensity VII earthquakes, damage is negligible in buildings of good design and construction, slight-to-moderate in well-built ordinary structures, considerable in poorly built or badly designed structures such as unreinforced masonry buildings. Some chimneys will be broken.

Intensity VI Earthquake Areas

Recluse
Rozet
Spotted Horse
Weston
Alcova

Arminto
Natrona
Powder River
Waltman
Bill
Lost Springs
Shawnee

In intensity VI earthquakes, some heavy furniture can be moved. There may be some instances of fallen plaster and damaged chimneys.

Intensity V Earthquake Areas

Rockypoint

In intensity V earthquakes, dishes and windows can break and plaster can crack. Unstable objects may overturn. Tall objects such as trees and power poles can be disturbed.

### 2.6.7 References

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Campbell County, Wyoming,* (Wyoming State Geological Survey, September 2002)

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Converse County, Wyoming,* (Wyoming State Geological Survey, September 2002)

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Johnson County, Wyoming,* (Wyoming State Geological Survey, September 2002)

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Natrona County, Wyoming,* (Wyoming State Geological Survey, January 2003)

Conoco, Inc. 1980. Environmental Report for the Sand Rock Mill Project, Campbell County, Wyoming, Nuclear Regulatory Commission, Docket No. 40-8743. July, 1980.

Conoco Inc. 1982. Moore Ranch Mine and Sand Creek Mine Project, Campbell County, Wyoming. Wyoming Department of Environmental Quality Mine Permit Application. Prepared by Conoco Inc. Minerals Department.

Sharp, W.M., McKay, J.E., McKeown, F.A., and White, A.M., 1964, *Geology and Uranium Deposits of the Pumpkin Buttes Area of the Powder River Basin, Wyoming*, USGS Bulletin 1107H, pp. 541-638.

U.S. Department of Agriculture 1975. *Soil Taxonomy.* U.S. Dept. of Agric. Handbook 436, 754 pp. Government Printing Office.

U.S. Department of Agriculture 1993. *Soil Survey Manual.* U.S. Dept. of Agric. Handbook 18, 437 pp. Government Printing Office.

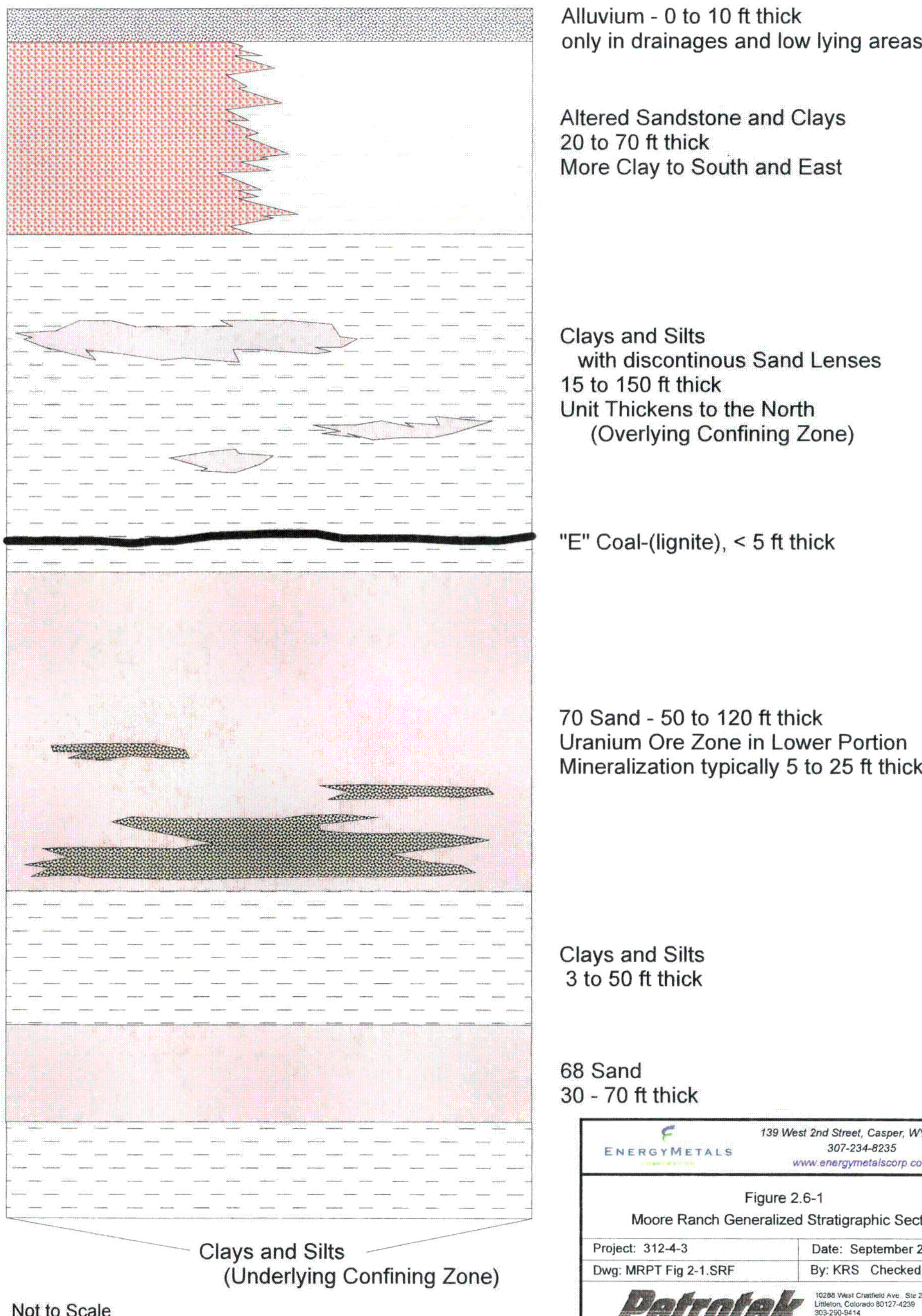
Wyoming Department of Environmental Quality, Land Quality Division. 1994. *Guideline 1, Topsoil and Overburden including selenium update.*

Wyoming Department of Environmental Quality, Land Quality Division. 1994, Attachment III update 2000. *Guideline 4, In Situ Mining*

# ADDENDUM 2.6-A

## Section 2.6-2 through 2.6-4 - Figures and Tables

**Section 2.6-2 Figures**





ENERGYMETALS
139 West 2nd Street, Casper, WY 82601
307-234-8235
www.energymetalscorp.com


Figure 2.6-1

Moore Ranch Generalized Stratigraphic Section

| | |
|---|---|
| Project: 312-4-3 | Date: September 2007 |
| Dwg: MRPT Fig 2-1.SRF | By: KRS Checked: HPD |


Petrotek
10288 West Chatfield Ave., Ste 201
Littleton, Colorado 80127-4239
303-290-9414
www.petrotek.com

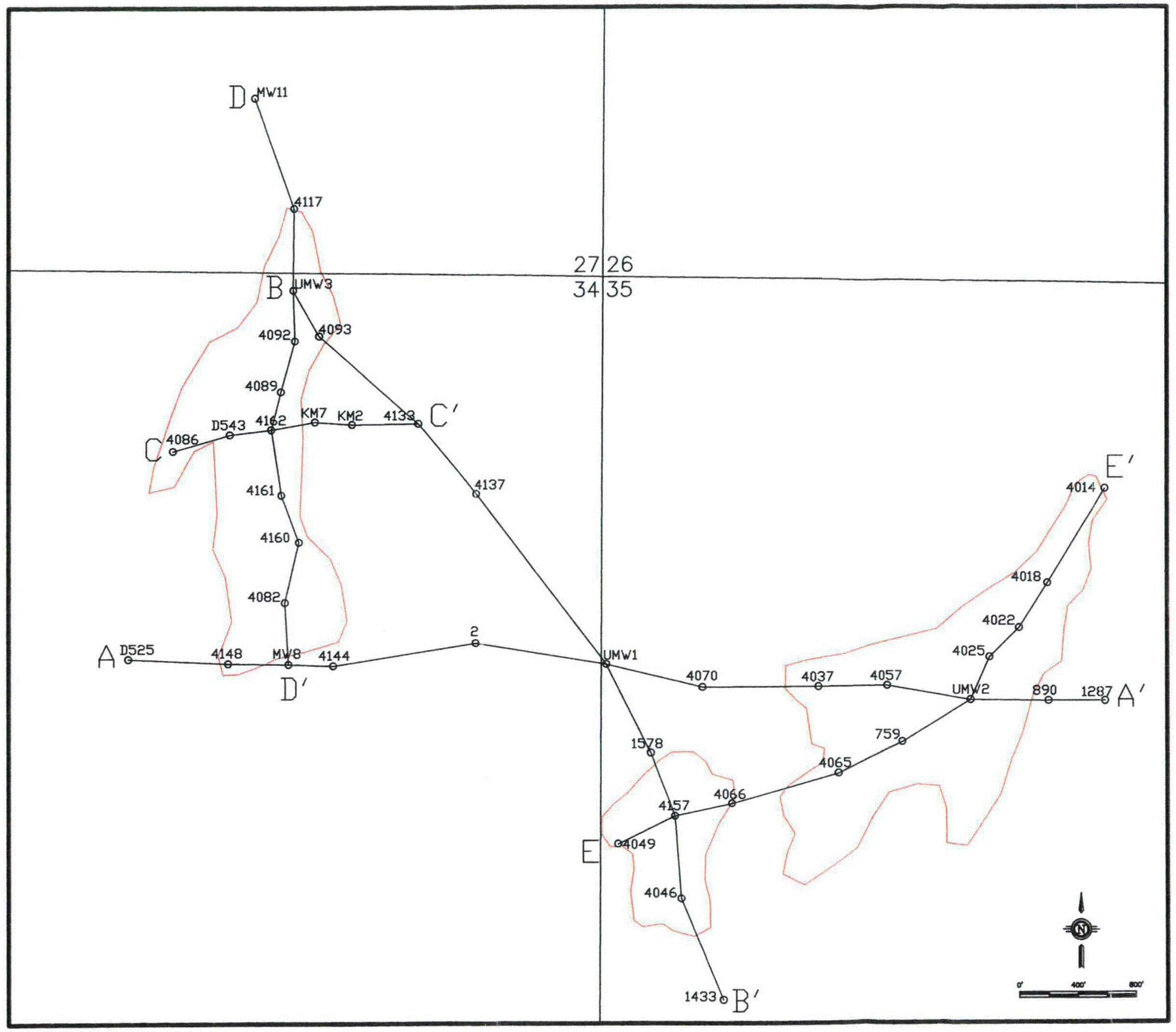



Figure 2.6-2

*ENERGY METALS CORPORATION, US*

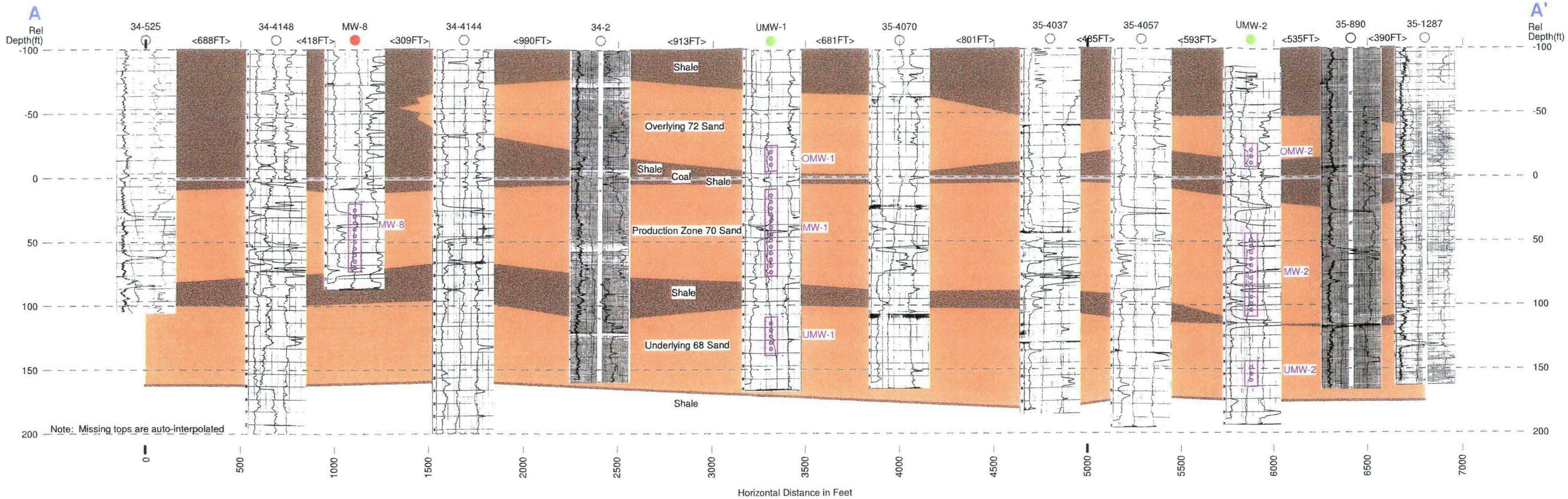
*139 West 2nd St. Casper, WY 82601 307-234-8235*

| REVISIONS | | |
|---|---|---|
| NO. | DATE | BY |

**MOORE RANCH PROJECT**

**Cross Section Index Map**

SECT. 26, 27, 34, 35, T. 42 N., R. 75 W.




Petrotek

ENERGY METALS CORPORATION

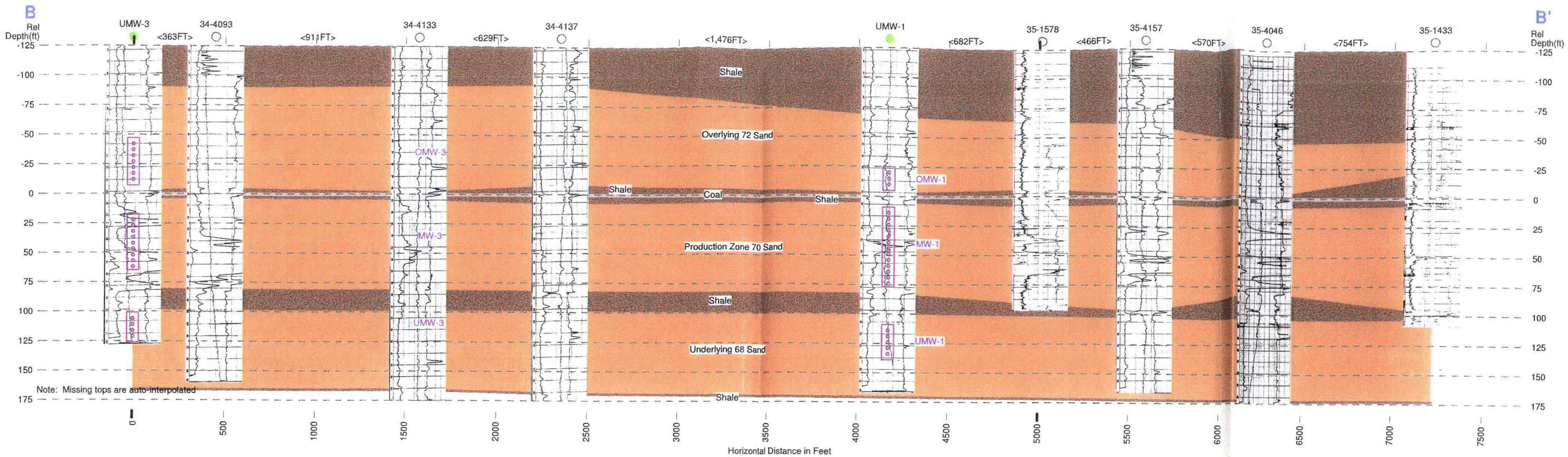
Figure 2.6-3

NRC License Application Technical Report

Stratigraphic Cross Section A-A'

August 2007

By: KRS Checked: HPD/EL




Petrotek

ENERGY METALS CORPORATION

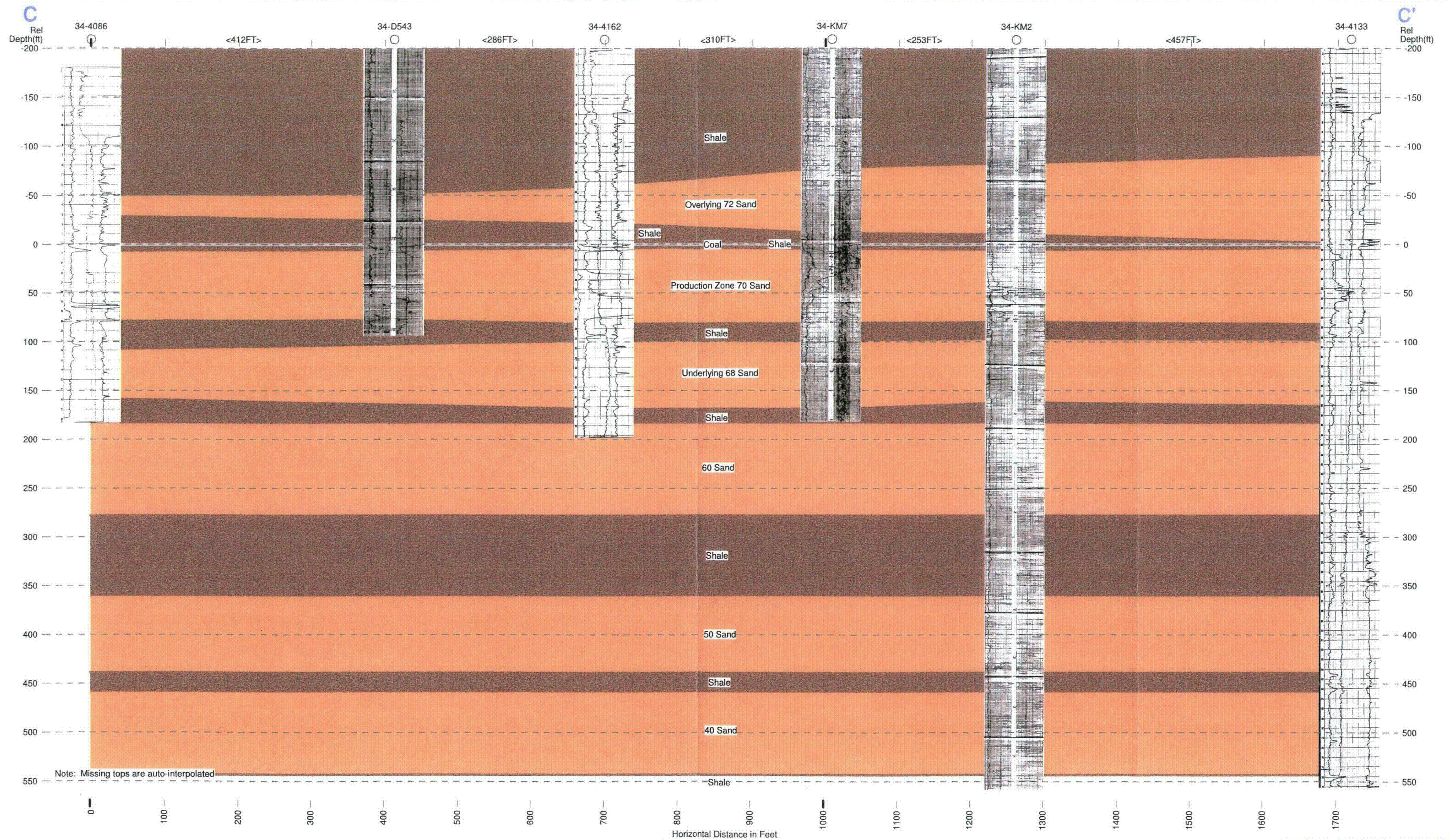
Figure 2.6-4

NRC License Application Technical Report

Stratigraphic Cross Section B-B'

August 2007

By: KRS Checked: HPD/EL




Petrotek

ENERGY METALS CORPORATION

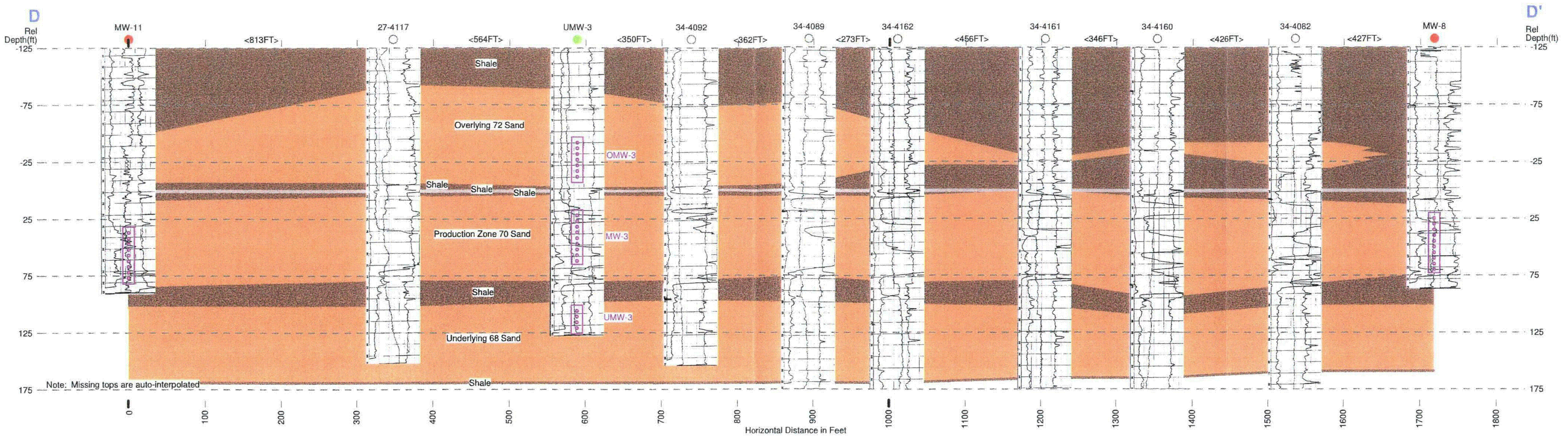
Figure 2.6-5

NRC License Application Technical Report

Stratigraphic Cross Section C-C'

August 2007

By: KRS Checked: HPD/EL




HS=75

Petrotek

ENERGY METALS CORPORATION

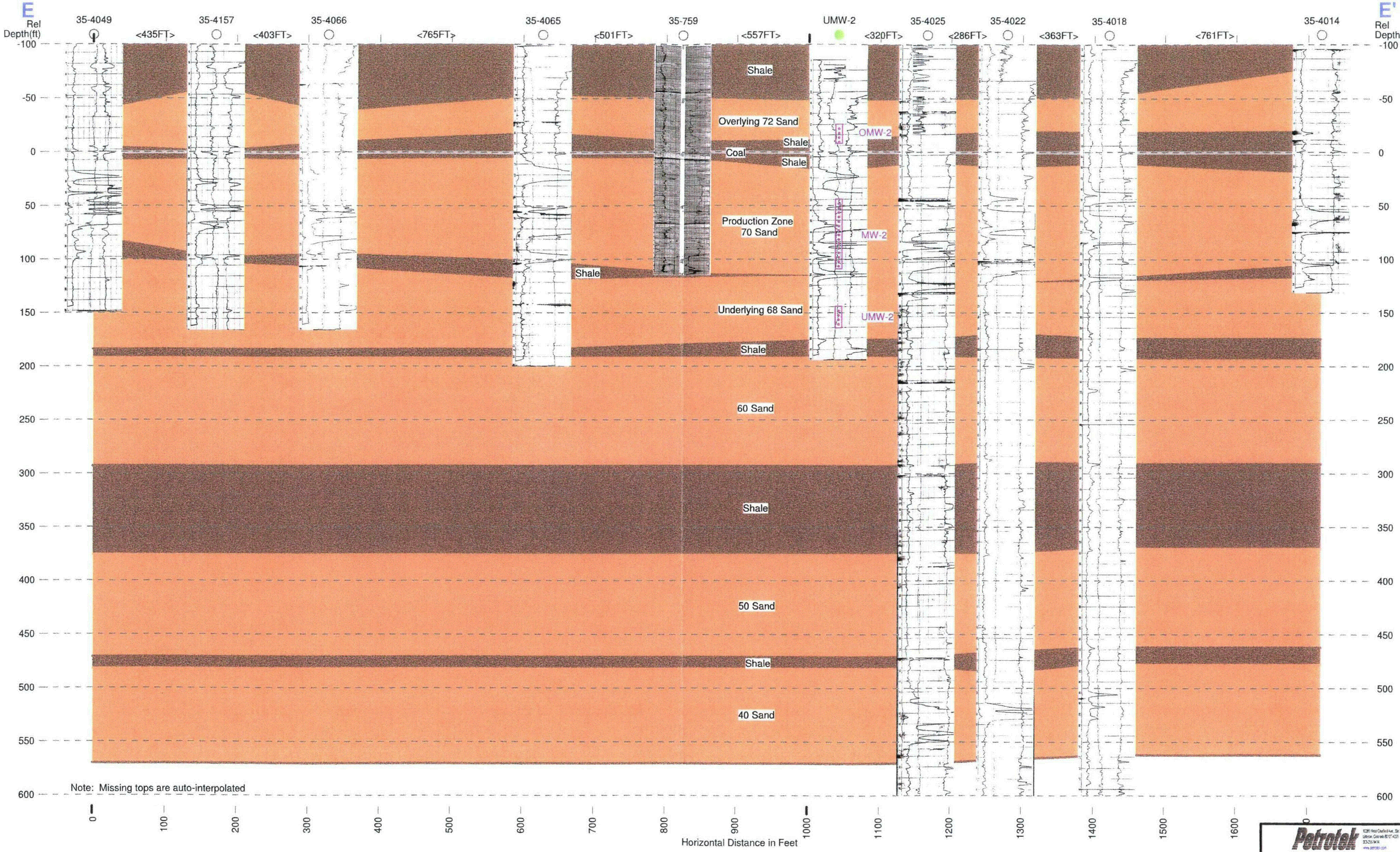
Figure 2.6-6

NRC License Application Technical Report

Stratigraphic Cross Section D-D'

August 2007

By: KRS Checked: HPD/EL




Petrotek

ENERGY METALS CORPORATION

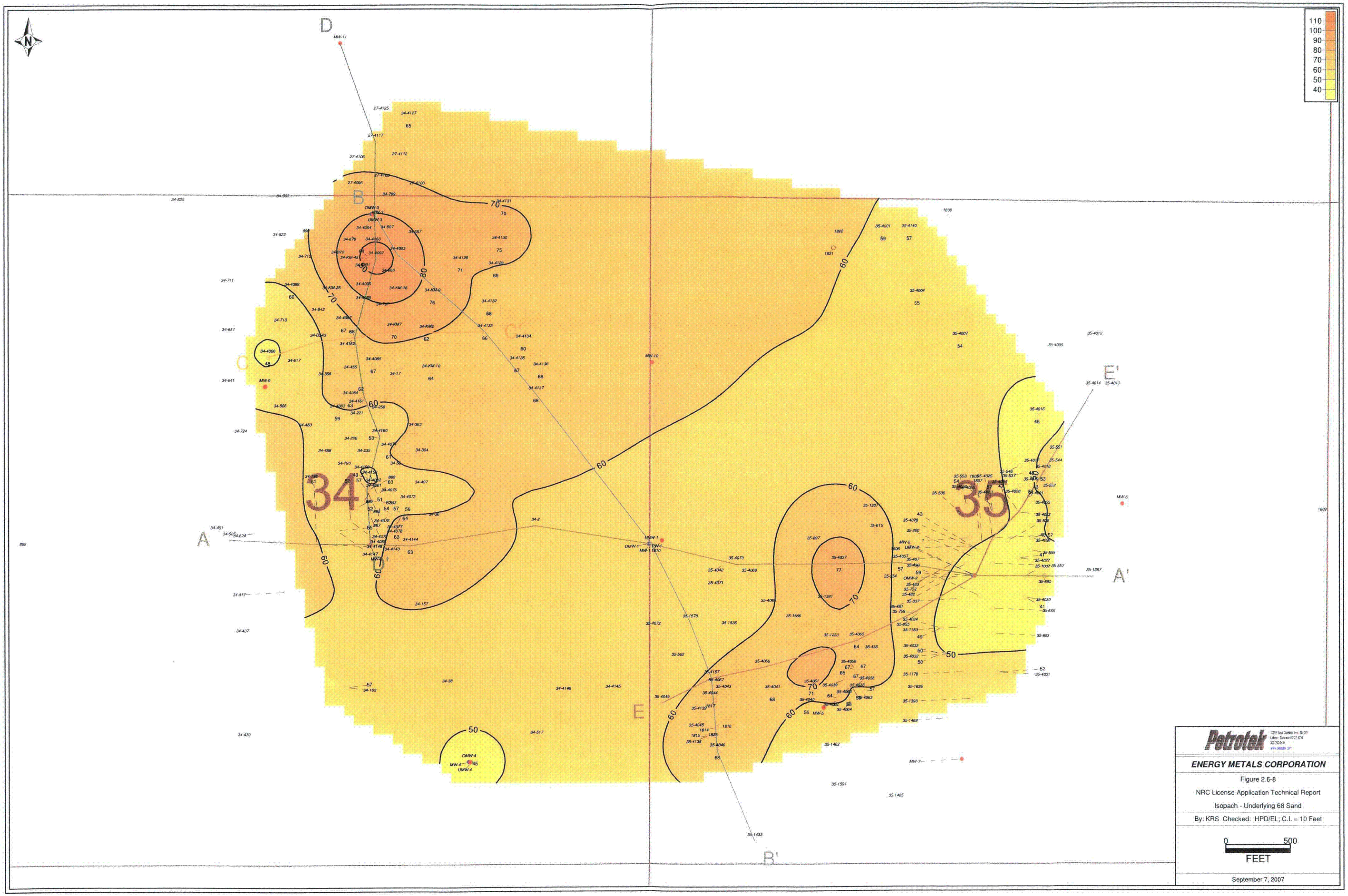
Figure 2.6-7

NRC License Application Technical Report

Stratigraphic Cross Section E-E'

August 2007

By: KRS Checked: HPD/EL




ENERGY METALS CORPORATION

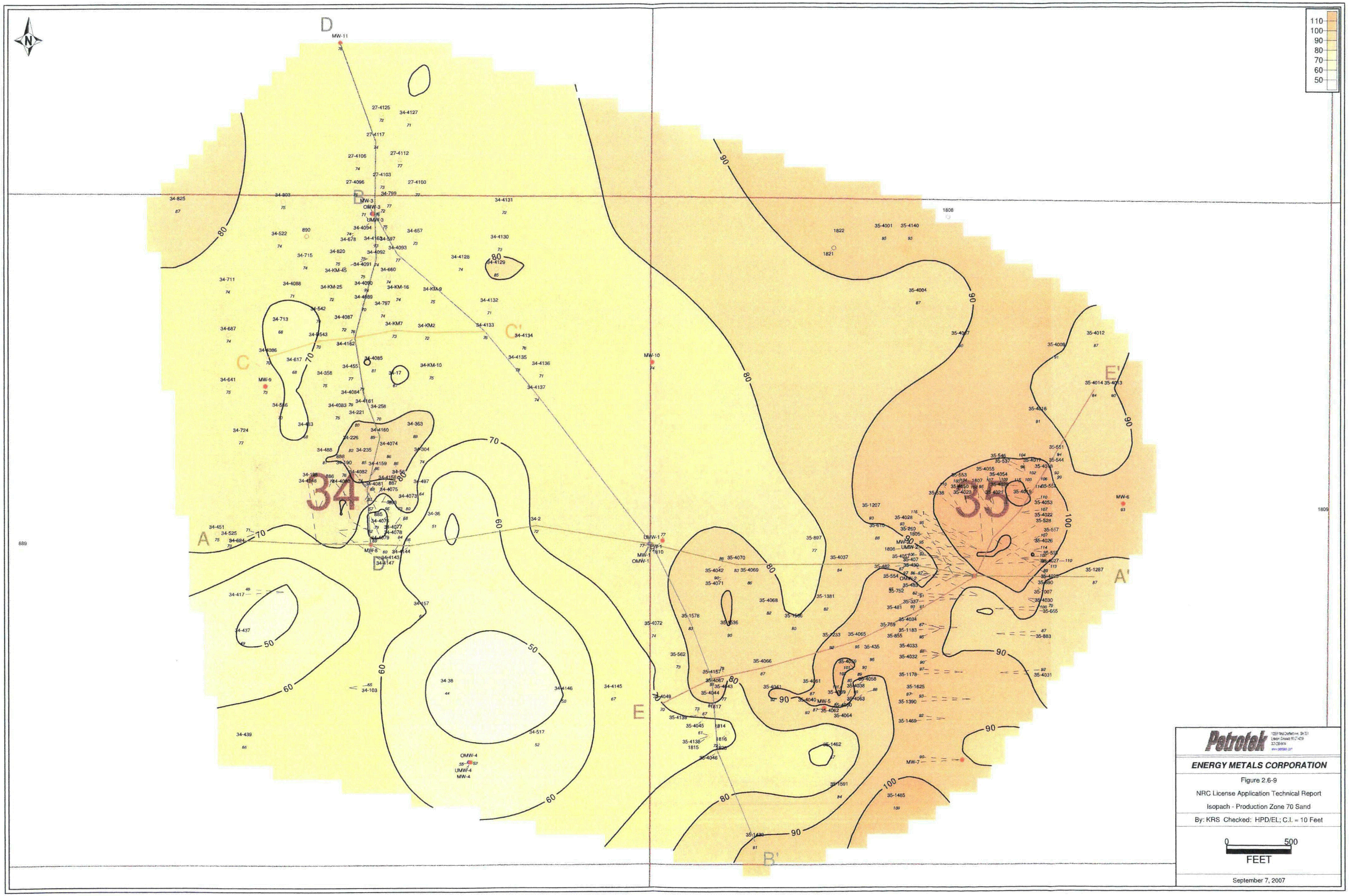
Figure 2.6-8

NRC License Application Technical Report

Isopach - Underlying 68 Sand

By: KRS Checked: HPD/EL; C.I. = 10 Feet

September 7, 2007




Petrotek

**ENERGY METALS CORPORATION**

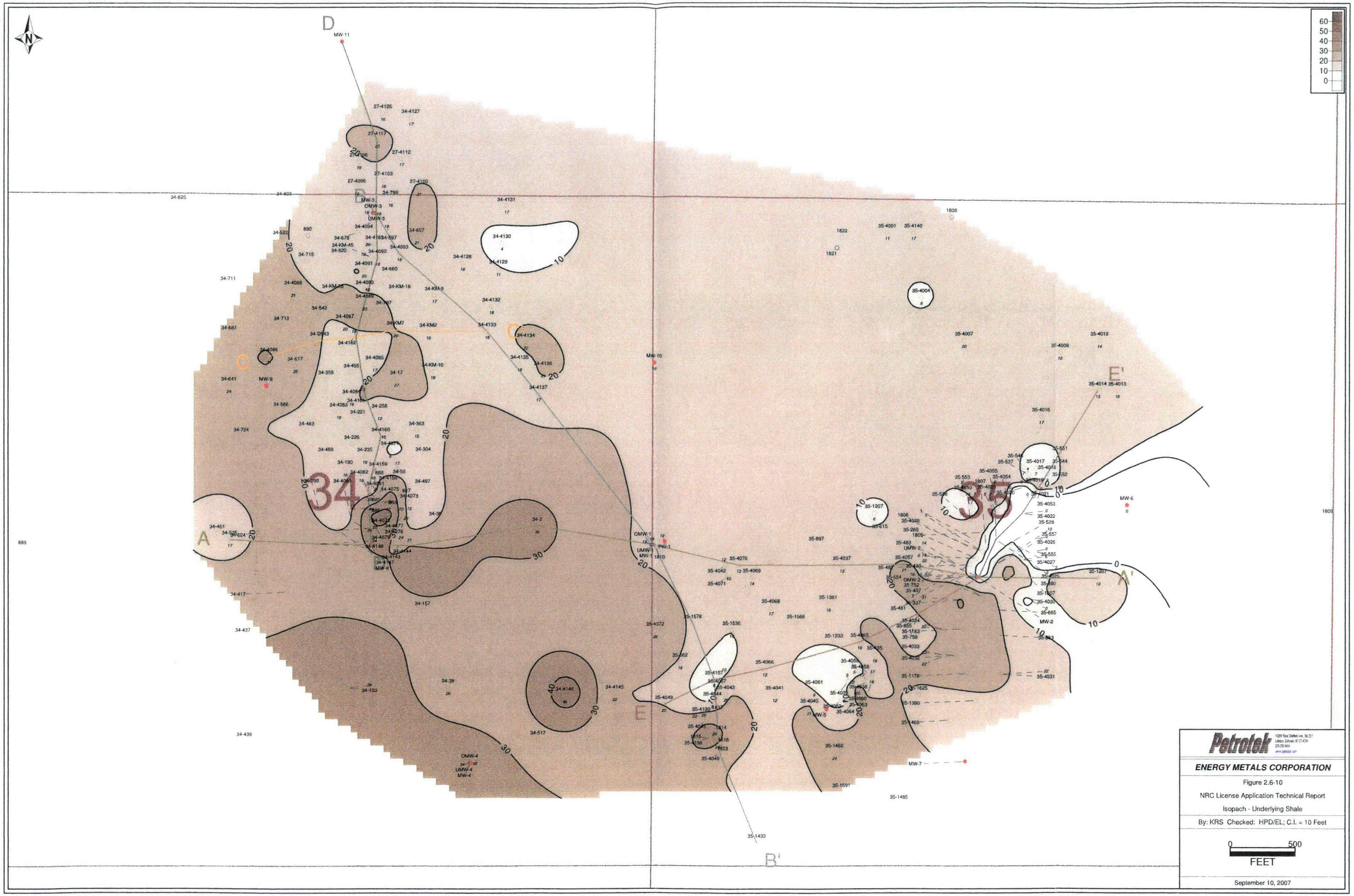
Figure 2.6-9

NRC License Application Technical Report

Isopach - Production Zone 70 Sand

By: KRS Checked: HPD/EL; C.I. = 10 Feet

September 7, 2007




Petrotek

**ENERGY METALS CORPORATION**

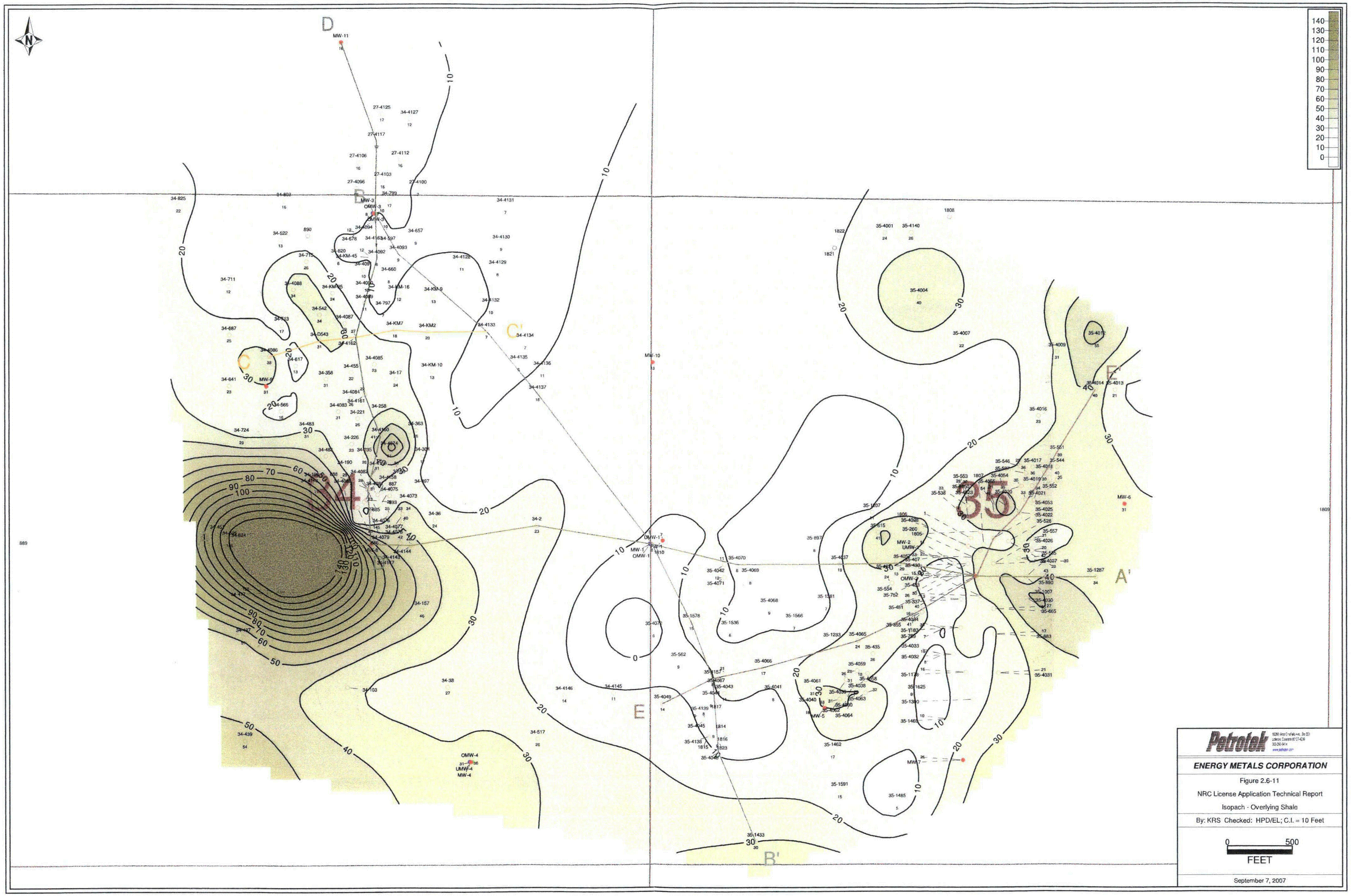
Figure 2.6-10

NRC License Application Technical Report

Isopach - Underlying Shale

By: KRS Checked: HPD/EL; C.I. = 10 Feet

September 10, 2007




Petrotek

ENERGY METALS CORPORATION

Figure 2.6-11

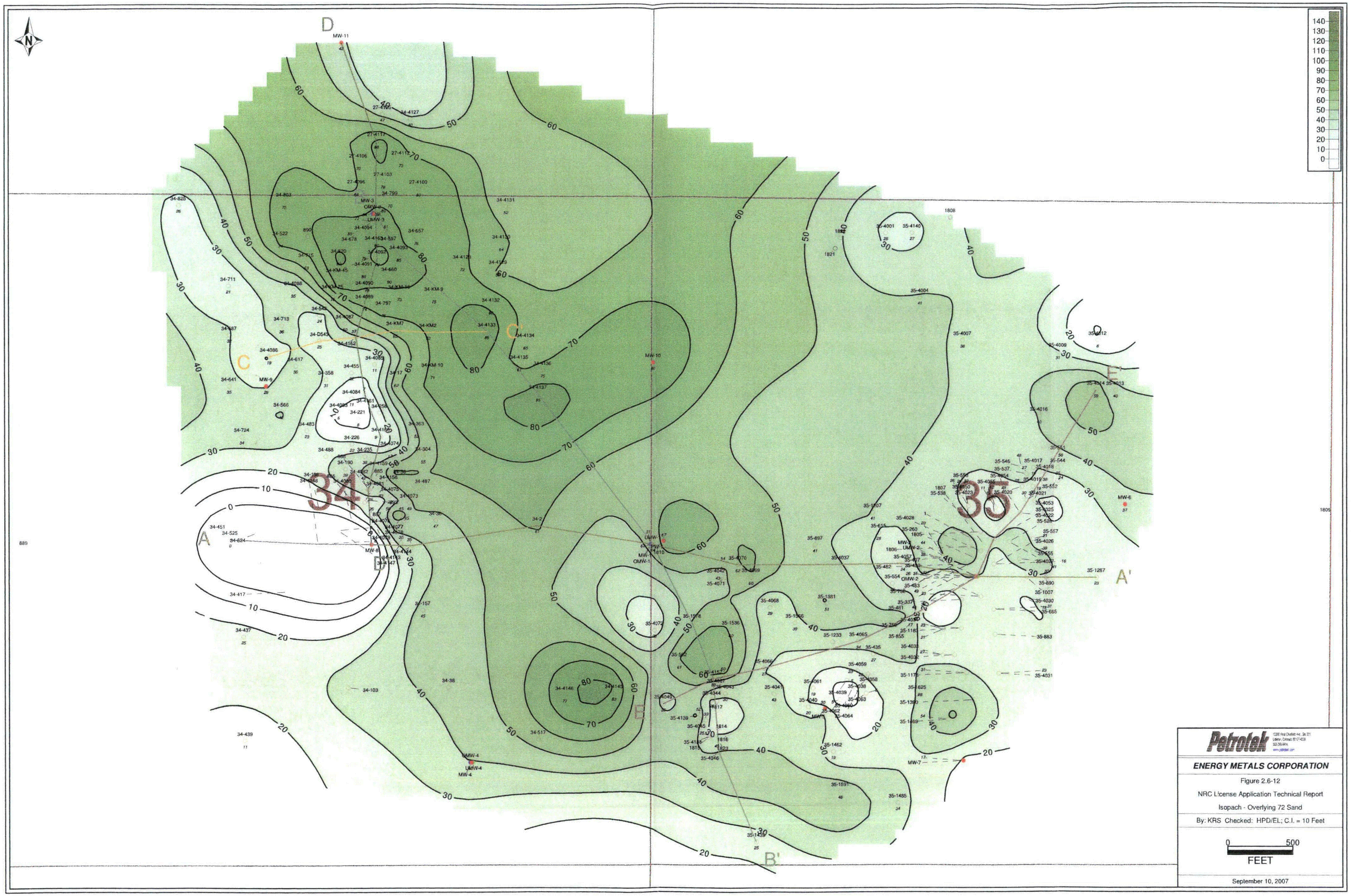
NRC License Application Technical Report

Isopach - Overlying Shale

By: KRS Checked: HPD/EL; C.I. = 10 Feet

0 500
FEET

September 7, 2007




ENERGY METALS CORPORATION

Figure 2.6-12

NRC License Application Technical Report

Isopach - Overlying 72 Sand

By: KRS Checked: HPD/EL; C.I. = 10 Feet

September 10, 2007